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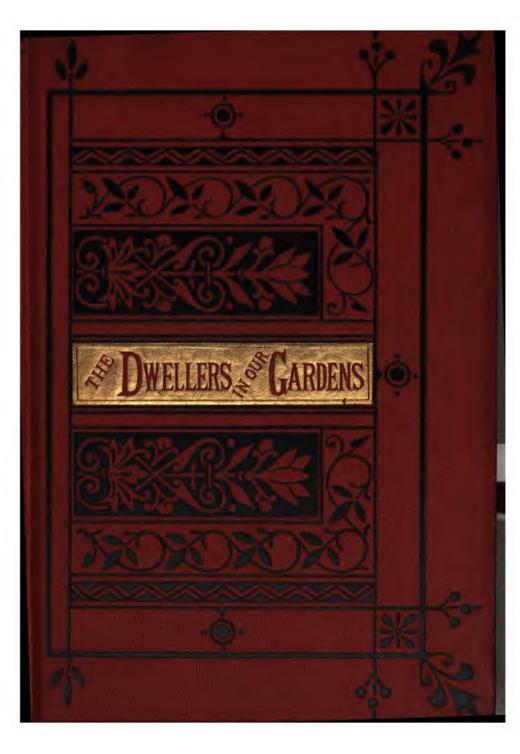
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INSECT DISGUISES.

DWELLERS IN OUR GARDENS

THEIR LIVES AND WORKS.

By SARA WOOD,

Author of "The Gift of Life," &c.

"He prayeth best, who loveth best
All things both great and small,
For the dear God who loveth us,
He made and loveth all."

COLERIDGE.



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DESCRIPTION OF COLOURED PLATES.

Plate 1.

INSECT DISGUISES.

"A LARGE number of insects wear disguises, the study of which is most interesting on account of its very close bearing upon their history. In all cases of disguise it will be found to be of vital importance to the insect; and that portion of its structure which is concealed by the disguise often presents a striking contrast to the rest. Our common white butterflies are familiar but good examples. their colouring being so arranged that not a particle of the very conspicuous white is exposed when they are asleep, but only the dusky vellowish which colours the under sides of the hind wings and the tips of the fore wings. It may be further observed that this yellowish colour alone is visible only when the creature rests strictly speaking, and not when it merely settles on a leaf or flower on a sunny day-for the wings are then more or less open, and the white shows strongly; but in this case the insect is always thoroughly on the alert, and would avoid any appproaching enemy by flight, while in the evening, or on very dull days, they are fast asleep, and, when found, as easy to capture as the plucking of the flower which they resemble. Their disguise is also aided by the fastidious care which they may be observed to use, as evening approaches, in choosing their sleeping-places, as they often change their places many times before settling down for the night."

"The Anthocharis cardamines, or orange-tip butterfly, is most wonderfully protected by the colouring of its under surface when it is resting at night on the buds or blossoms of the Anthriscus sylvestris, or wild parsley, or some other small white flower, as shown in the plate. The insect is not seen to touch the wild parsley for any purpose but sleep, as it visits the little pink geranium, during sunshine, for the nectar it contains, at which time the wings are open, although not widely expanded."

Description of Coloured Plates.

"The Blue Butterflies may be found in the evening, resting with their heads downwards on the buds and blossoms of grass, plantain, etc., which with their beautifully-spotted undersides and general appearance when in the attitude shown in our plate, they so closely resemble that they usually escape notice."

"The Phlogophora meticulosa, or angle-shades moth, shown in the plate, is remarkable from its peculiar and probably unique appearance during the day, its time of resting, the fore wings being curled on their outer margins, thus adding greatly to the disguise, which is evidently that of a withered, dried-up leaf. The curl disappears immediately when the moth prepares for flight, and the wings then become as flat as those of any other insect."

"There is a small moth belonging to the genus Antithesia, very common in gardens, shown on the central leaf in the plate, which, when at rest, is exactly like the excrement of a sparrow, or other small bird, and, as we always find, the disguise it wears suits its habits, for it sits fully exposed to view on the upper surface of leaves, etc., and will drop off when the leaves are shaken as if it were really a lifeless object."—Curiosities of Entomology.

Plate 2.

BUTTERFLIES AND MOTHS.

- Fig. 1. Red Admiral Butterfly. Vanessa atalanta.
 - , 2. Brimstone Butterfly, Gonepteryx rhamni,
 - ,, 3. Common Blue Butterfly. Polyommatus alexis.
 - ,, 4. Humming Bird-moth. Macroglossa stellatarum.
 - , 5. Tiger-moth, Arctia caja.
 - , 6. Lappet-moth. Gastropacha quercifolia.
 - ,, 7. Clearwing-moth. Sesia apiformis.
 - , 8. Alucita Polydactyla.

Plate 3.

OUR GARDEN CHORISTERS.

Robin, Blackbird, and Thrushes.

Description of Coloured Plates.

Plate 4. GOLD-CRESTED WREN.

Plate 5.

BIRDS' EGGS.

- Fig. 1. Nightingale.
 - ,, 2. Blackcap.
 - .. 3. Garden Warbler.
 - 4. Whitethroat.
 - ,, 5. Wood Warbler.
 - , 6. Willow Warbler.
 - . 7. Chiffchaff.
 - .. 8. Wren.
- ,, 9. Gold-crested Wren.

Plate 6.

MOTHS OF LEAF-MINERS.

But few observers have devoted any attention to these interesting moths, although of such beautiful hues and metallic lustre, glorious as the Admiral and Peacock butterflies in the variety and richness of their colouring, whilst in their instincts they are as wonderful as any of their larger brethren. In our plate we give representations of our commonest leaf-miners, highly magnified, the natural size being indicated by minute figures or by lines beneath.

"It was one of the wonders of my childhood," says Mrs. Lane Clarke, "what the hieroglyphics upon primrose, bramble, and rose leaves could possibly mean. I saw a white winding stream meandering along with a dark wavy line in the centre, beginning at a mere speck and swelling into a broad river, then suddenly ending. Holding a rose leaf to the light, one day, there was life within that winding way, a sheltered, naked little worm sustained in the narrow channel between the upper and lower cuticle of the leaf; food, safety, warmth, all provided within the limits of the rose-leaf mine. Picking open the upper skin and finding a small green cater-

Description of Coloured Plates.

pillar, curious to know its metamorphosis, and failing to preserve the larvæ in the gathered leaves, I bethought me of muslin bags, which I tied over the twigs of rose trees and brambles, laburnums, and lilacs, which were the first mined and rolled leaves I had observed; and great was my joy when from these pages of nature's own book I first learnt the mysteries of the microscopic moths. Every folded leaf is in truth the habitation of the larva of a minute Lepidoptera, and beneath the leaf a blotch, a pucker, or a tiny tent, will, if watched, produce one of these beautiful objects."

The beautiful plumed head of the Ochsenheimeria (Fig. 15), and the head of Coriscium (Fig. 16), an oak-leaf miner, plentiful in April, June, August, and September, with drooping and tufted palpi, show us the minute yet decided variations which mark the species.

- Fig. 1. Cemiostoma scitella. Hawthorn and Pear.
- Cemiostoma laburnella. Laburnum.
- Nepticula aurella. Blackberry.
- Nepticula trimaculella. 4.
- Nepticula sub-bimaculella.
- Nepticula anomalella. Rose-leaf.
- Lithocolletus stettinensis. Alder. 7.
- - 8. Tischeria marginea. Bramble.
- Glyphipteryx equitella. Stonecrop.
- 10. Elachista luticomella. Dactylis glomerata.
- Ochsenheimeria. Dactylis glomerata. II.
- Gelechia malvella. Hollyhock. 12.
- Cerostoma xylostella, Honeysuckle.
- Gelechia hermanella. Ghenopodium,
- Head of Ochsenheimeria. ,, 15.
- Coriscium. Oak.

All these figures are highly magnified. The natural size is given in the lines beneath each, or in a minute figure.

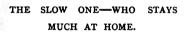
Fig. 17. Examples of different larva mines: a, mine of Nepticula aurella on the Bramble. b, mine of the Nepticula anomalella on the Rose-leaves. c, mine of Nepticula viscerella on the Elm. d, mine of Nepticula marginicolella on the Elm.

THE

DWELLERS IN OUR GARDENS:

THEIR LIVES AND WORKS.

CHAPTER I.



HE dweller in our gardens, whom we call the "Slow One," is, from his very slow and measured pace, not only easy to be seen when he happens to be abroad, but from his quiet and secluded

habits can generally be found at home when he is wanted. Some people have described him as never going from home, and as carrying his house

with him on his back at all times; but we shall show that this is a wrong notion, and though by nature his body is provided with a comfortable and convenient covering, yet he requires a dwelling-place as well as other creatures. We shall find that he likes above all things a nice little retired nook to live in-shady, cool, and damp, under the shelter of leaves and branches, or on the shady side of a bank, or among stones or tree trunks—anywhere so that it is secluded, cool, and shady. Never, by any chance, is he to be seen taking a walk in the glare and warmth of the hot noon-day; but before the sun has risen, or not had time to mount up high in the heavens, and when the early dew is still on the grass and every flower and leaf moist with it, the Slow One may be seen making his way as fast as he can crawl towards some juicy lettuce or cabbage leaves, or succulent young flowering plant or bed of seedlings, to eat his breakfast. There are other times, too, when he will venture forth from home; as, for instance, when a shower of rain has just fallen, and made the ground soft and damp, and when every leaf and blade of grass is dripping with rain-drops, and the sun still hid behind rain-clouds—then he will all at once unglue himself from his tree-trunk, stone, or wall, and raising up his shell, poke out his head and stretch out his one great foot, and first thrusting up his two tallest horns, and then putting out his two smaller ones-will glide forth with his usual slow, dignified, and not ungraceful pace, to take a second meal.

Learned people give the name of 'Helix aspersa' to our slow friend. Helix, because that is the Latin for a coil or a screw, and describes the form of his outer covering or shell; and aspersa, because of the spottings and blotches of darker colour on the whorls or windings of From the softness of his body, the snail—whom, after all, we must call by his most common name sometimes—belongs to the large class of animals which are called Molluscs or Mollusca, from the Latin word mollis, soft: and then he has another family name, made up of two Greek words, which describe his manner of crawling on his stomach as if it were a large foot, so that all molluscous animals who crawl in that manner, whether on land, or at the bottom of the sea on sea-weeds and rocks, are called gastero-poda, or stomach-footed. Like most other living creatures, the snail requires air for his support, as well as food. If we observe him closely as he is crawling abroad, we may perceive a round opening come every now and then under the edge of the shell at his right side. He is taking air into his lungs; and air is as much needed for the growth of his body, and the continuance of his life, as with ourselves. As he eats, too, we can see that there is something which he can do quickly, like ourselves, since the rapid motion of his mouth as he munches his leaves is very perceptible, it being provided with a hard and toothed upper jaw. Let us notice, too, his delicate and flexible horns, at the tips of which are his round eyes, and admire the grace with which he bends them this way and that as he crawls, as if to look about him. Small round knobs are these eyes of his, without lid or lash, so no wonder that he avoids the glare of bright sunshine. But instead of an eyelid to shut over them, how easily he can protect his organs of sight by drawing the eye with the whole horn into his head again at the approach of the slightest danger. With what delicate muscles must not this be effected within that slender horn! He has the sense of smell—that we are sure of, from his detecting so far off his favourite food: but we know not where are his organs of smell. Are they at the tips of the short horns nearer his mouth, and do these small knobs at their end act as noses or nostrils, or is there all over the body the power of perceiving in the air odoriferous particles, imperceptible to our sight and smell, which come from the plants he feeds on ?

It seems to us when he gathers himself so completely up into his shell, and fastens himself so closely against some smooth surface after a meal, as if he then meant to sleep; but we really know little about it, for it is quite certain that while he is so quiet and still something is going on very important to the Slow One. Of course he is growing all the time, like every other creature, nourished by the particular food which is suited to their natures; the food adding fresh material to the body, and the operation which we call digestion helping to change the food into the matter wanted for the building up of the body, or for repairing the waste of what is used up by the act of living; and yet something else besides this



goes on within the creature we are describing. grow our bones grow with us and help to give support and strength to our bodies, and make us what we are -strong and upright creatures, able to move about easily and with the soft fleshy parts of our limbs outside our hard bones. But with the soft-bodied race to which our garden friend belongs, the hard parts most often come outside. They answer the same purpose as bones in some respects, and serve to protect their tender bodies, especially those of the race who inhabit the sea, where they are constantly exposed to the buffeting of waves and the ebbings and flowings of tides. Like our bones, shells are principally composed of lime, but somehow it seems as if the animals who are covered with them had more to do with the making of them than we human creatures have to do with the growth of our Their shells are made of matter which oozes out of their soft bodies—part lime and part a sort of animal glue, which hardens into the covering they want outside them.

Our Slow One, therefore, seems to have something to do, while apparently idle or asleep, in building up the whorled shell which protects him. We have described the kind of dwelling places in our gardens that he generally chooses for a home, and perhaps it is not far from such nooks that he may have been born. In a hole in the earth, half hid by a stone, perhaps, was dropped by its parent, one by one, a bunch of little white eggs, about the size of a small pea, and out of each of them in due

time came a tiny soft creature, with already the beginning of a shell upon its almost transparent body. The greater part of the body had a tendency from the first to grow in a spiral or twisting form, and the shell had the same tendency, or rather could not help doing so, as it grew in size with the growth of the small creature it was to cover and protect. The head could be freed at will from the shell envelope, and the foot on which it was to crawl, but the upper portion of the body was to be always attached to and covered by the shell; and as this part of the body grew and was always coiling round in its growth the shell too became spiral, and each whorl became larger than the one before, as it increased with the creature's growth.

Now the manner in which matter is constantly being added, so as to make the shell larger and larger, is a very curious affair. Almost all animals belonging to the soft-bodied race which are called Molluscs (or Mollusca), like the Helix of our gardens, have their bodies enveloped in a sort of loose skin, which has been called a mantle, because it wraps them round like a cloak or mantle. All sea molluscs, such as whelks and periwinkles, as well as those which have shells composed of two parts, like oysters and mussels, have the same envelopes or mantles, and it is round the edges of them that are the small pores out of which oozes the matter which builds up the shell. It is thus at the edge of the opening or mouth of the shell that the fresh matter is constantly added, and it naturally follows the growth of the

creature's body. While it is in repose, the mantle comes up to the very edge of the shell's mouth, and a fresh little layer of shelly matter is deposited. If we examine a shell with a magnifying glass, we can see how small furrows or ridges are left outside by these repeated additions, and we may observe too that more of the animal matter comes to the outside, and, drying, makes a kind of brown skin, while within the shell it is almost wholly composed of lime, and is kept smooth and polished like marble. The glue-like matter may be seen plainly at the edge of a young snail's shell projecting a little, like a film. The limey matter is added within it afterwards, making it serve as a mould. This same gluey matter, mixed, perhaps, with a little lime, seems to ooze out at all times from the body of the creature, and especially from his large stomach-foot as he crawls, leaving, as we know, a glistening white track behind him at all times; the same sticky matter being used for helping to fasten himself up against some object when at home. Thus it is that the shell always fits the growing creature—never too small or too large, or too tight or too loose, but always of the right size and form for covering the coiledup part, and for packing the whole body into when needed. Which of us can say the same of any of our own clothing?

While we are examining the shell, of which we have so many specimens at all times in our gardens that we forget to admire them, let us notice that it is curiously marked by some addition of darker-coloured matter, which must have been poured out at certain parts of the mantle from time to time, and which following the windings of the shell end in making elegant bands of spots, or rather blotches, around it; and we may also observe that its whole form is most beautiful and symmetrical. The coils of the shell, as it has grown, are as regular and exact as if following some law or rule, as any object made by art.



No clever artist or mechanic who might take out his ingenious tools, his compasses and rulers, and then sitting down, open out his learned books on geometry and other long-named sciences, and after studying them, might make trials and experiments, and calculate and recalculate; even then would not be able to design such graceful, pretty, and accurate coils as have been produced by nature while our garden friend has been digesting all his life's breakfasts! But, after all, the secret of the shape of the shell and its regularity comes from the shape of the creature itself, which, if it were taken out of its shell and laid straight, would present the strange form of a very tall fool's-cap, with its long foot and head at the bottom. The book about geometry would call it an "elongated cone."

See! what a strange figure our "Slow One" appears when divested of his elegantly formed and close-fitting shell garment, and stretched out to his real length! When we cut in half the empty shell of a snail, we shall also see how much more delicate and thin were the first

whorls of it, when the animal was young, compared to the very last whorl—the body as it grew requiring a thicker and thicker covering, while the point of the tall cone in our figure shows where was the beginning of the coiling, which now forms the apex or top of the spire of the shell.

And now let us ask what happens when the gardener gets rather savage at finding some of his choice lettuces or delicate seedlings nearly eaten up one morning, and then takes the trouble to trace the offender back to his hiding place by his silvery track? What happens if he should ruthlessly tear him from

his home, and intending to throw him over the garden wall fail to do so, and our friend, striking against the top-most brick of the wall, receives a violent blow, and falling down behind some tree is not killed, but stunned, while his shell is all crushed and broken—all his life's work, it would seem at first, quite spoiled. The broken edges of shell forced in against his tender body, and a piece of shell

gone, so that there, at the back of the last whorl is now a terrible hole, letting in the air, and making him feel dreadfully uncomfortable, besides altogether spoiling his whole appearance. Perhaps he recovers gradually from the shock—waits for nightfall, and then crawls home thus wounded and maimed; but we rather fancy that he stays where he is, fastens himself to the wall which has so cruelly injured him, and then and there mends himself! No surgeon wanted for him—no bandages needed, or forceps, or lancet. Friend Helix repairs his own shell. He keeps quite still, oozes out more limey and gluey matter just where it is wanted (for it would seem as if the whole of that envelope called the mantle can produce or secrete shell), and the matter dries and hardens; all is comfortable once more, and bye-and-bye he can, if he like, crawl home to his old nook again. Should you meet with him after this dreadful catastrophe, and examine the traces of the accident, you can just see where the shell patch has been put in, but that is all, for it is very cleverly done.

But the gardener is not the only enemy which the snail has to dread, since many birds feed on slugs and snails, the shells of the latter, be they ever so strong, not always protecting them from some of the larger birds. We may see even on our garden paths, near some particularly large stone which is embedded in the gravel, fragments of snail shell, where some thrush or starling has carried a snail to knock and crush its shell against the hard surface, leaving not a particle of its soft body after the meal; and

we have noticed frequently around some particularly large stone on the surface of a common, a circle of fragments of snail shell, showing where birds have often used the stone in preparing their dinners; so that the snail, while nourishing his own body with his natural vegetable food, supplies to other animals their natural food—just as the grass-eating sheep furnishes food for mutton-eating men. It is to be so, by a law of nature, and we need not look upon it as a terrible or cruel law, but rather one to be reverenced and obeyed, though we should try at all times, and above all things, to respect and spare life as much as it is possible.

We have said that 'Helix aspersa' likes coolness and damp and dislikes warmth, but it is also true that he avoids the cold of winter and spends that season in a kind of stupor or sleep, taking no food, and never unfastening himself from the smooth surface of bark or wall or stone to which his shell is attached; and besides glueing himself round the edge of his shell to such a surface, he also covers the mouth of the shell inside with a thin coating of shelly matter, and withdraws still farther back into his largest whorl. Perhaps for the sake of getting a little warmth from each other, a number of his family, on the coming on of cold weather, will fasten themselves to the shells of each other, the mouth of one shell being made to adhere to the back of the last whorl of another until a large ball is formed. What a curious sight must it be, when, on some mild, damp morning in early spring, the whole assembly of Slow Ones awake from

their winter sleep, and unpacking themselves from their ball, crawl off, each his way, to break his long fast!

'Helix aspersa' has many relations—some of them very like himself, and others only distant cousins, though all have several very striking points of resemblance.





HELIX NEMORALIS.

'Helix nemoralis,' for instance (whose name means 'of the woods'), who is of a more delicate and refined nature, also lives sometimes in our gardens, where disdaining such common fare as lettuce or cabbage leaves, he selects the tender foliage of the grape vine for his diet, while, as his name betokens, he is also to be found in country hedges, and among the moss about the trunks of trees. It is no doubt from the delicacy of his food that his shell is more fine in texture, and of a pale yellow or straw colour, elegantly banded with brown.





HELIX HORTENSIS.

Another, called 'Helix hortensis' (or 'of the garden'), may also be found in some of our gardens, and is to be distinguished from 'nemoralis' by a greater number of stripes around the shell, which is finished off with a pretty rim at the mouth, while the graceful and almost transparent body shows that the creature lives on delicate leaves and fruit. 'Helix arbustorum,' or the shrubsnail, is also found in some country gardens, especially where there are shrubberies and plantations of young trees; and where gardens happen to have ponds in them, in which chickweed grows on the surface, or which have other fresh-water plants growing in the mud at the



HELIX ARBUSTORUM.

bottom—such as the pretty water ranunculus, which, while it has its roots in the mud, and fennel-like foliage under the water, sends up to float on the surface its delicate white blossoms and round glossy leaves. When this happens, we may be sure to find many shell-covered molluscous animals feeding on these plants which are near relations to the Helix. The 'Lymnea stagnalis,' for instance, is sure to be there, clinging to the stalks or leaves, or swimming on the surface of the water, the bottom of his foot serving as a kind of float, while his shell and body hang downwards. The shell

of this water-snail is more spiral than the land shells, while in another variety of fresh-water snails often found



LYMNEA STAGNALIS.

in ponds, called the 'Planorbis' (which name means 'flat-round'), the whorls of the shell are wound round like a flat coil of rope. In all these creatures the cone-shaped part of the body gets its shell covering, while the head and foot can also be drawn at times into it for protection and shelter.





PLANORBIS CORNEUS.

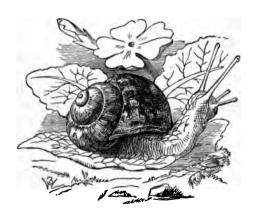
PLANORBIS CONTORTUS.

Perhaps the Helix thinks the slug or Limax but a sort of poor relation, and of a very inferior nature to himself, crawling about as he does with his long, dark, slimy body unprotected by any shell. One of his brother slugs, to be sure, does bear upon his back a flat piece of shell, like a shield, but this one is of a still coarser nature, and instead of feeding on vegetables like his brethren and cousins, likes nothing so much as flies and beetles for his daily fare.

And now to return to 'Helix aspersa,' whose life is spent in our gardens, and whose manner of life we have described, we have only left to tell that his shell building goes on until his body has attained its full size, and then it seems as if he meant to take a little rest, or in other words when he stops growing no larger shell is required for him. When this time comes, he completes his shell with a sort of moulding or cornice round the mouth of it, as if to give it a finish and make it strong, and having done this—if the gardener and the birds will let him—lives on to the natural end of his quiet and secluded And must not we who have been laying bare and looking into some of the secrets of that quiet life, feel after so examining into his nature and ways more respect than we have hitherto been accustomed to feel for a creature so often seen and so contemptuously spoken of? —and who yet, after all, is gifted with some of the same senses as ourselves—sight, smell, taste—so that we perceive that it has been intended that he too should enjoy life, and that even when he is doing us the greatest mischief that he can, is, after all, but living according to the nature given to him; while if we are at all inclined

to doubt whether he values his life, and in common with all other living creatures, has had given to him a desire to preserve it, together with some power of protecting it from danger, we may

"Give but his horns the slightest touch,
His self-collecting power is such
He shrinks into his 'shell' with much
Displeasure."



CHAPTER II.

THE SPINNER AND WEAVER.

OR a greater part of the year, especially during the late autumn months, there are to be seen suspended in our gardens, among the boughs of trees and shrubs, or in the angles of gates or doorways, samples of the beautiful workmanship of the clever Spinner and Weaver, who is sure to live there. When the morning sun

happens to fall on the delicate fabrics, making them glisten like spun glass or silver, or when the dew has left tiny beads upon them which reflect all the colours of the rainbow, or when some early morning frost late in autumn has frozen the dew-drops so that the whole looks as if carved out of ivory, then it is that the texture of these elegant hangings is most easily seen, and their wonderful workmanship shown to the greatest advantage. But though we may admire them very much, we know full well that they are not hung there to adorn our gardens and excite our admiration, but are constructed to serve a very important purpose in the life of the

Spinner and Weaver. For though we may pretend to describe them as tapestry hangings, or even call them webs, they are, after all, nothing more or less than nets wheel-shaped nets, with which the makers of them catch the prey on which they live, and which is their natural food. We should not look far before finding in the centre of one of these nets the maker of it sitting patiently awaiting its prey. If the net is a particularly large one, we may be sure that the spinner and weaver of it is also large, and yet its size, in proportion to the circumference of the net, is just as if some human weaver had woven a round carpet or rug, whose measurement across from one side to the other was twenty or even thirty times the length of his own body; and we may remember, too, that the human weaver would be sure to have a frame and some sort of machinery to weave his web with, while our garden weaver has nothing but his own limbs with which to measure and fasten the warp and the woof of his web, and, moreover, has been the spinner of the thread himself with which it is woven. All this-together with the wonderful accuracy and regularity of the workmanship, and other circumstances which we shall have to relate, causes the Spinners and Weavers who live in our gardens to be considered the very cleverest of all the creatures who dwell there. They have more of what looks like mind or reason, and something which seems to pass beyond what we are accustomed to call "the instinct of animals," and seems to show that they can plan, and project, and measure, and

calculate in making their nets, and then end with displaying great dexterity and cunning (as we shall see) in capturing and securing their prey.

And now we must tell a story about the name of the Spinner and Weaver, which was given to his ancestors very long ago. There was, it is said, a young Greek girl called Arachne, the daughter of a dyer who lived in Ionia, who was greatly renowned for her spinning and weaving—her father very likely dyeing the wool and flax and silk with bright colours, which his daughter afterwards spun and wove. At last the renown which Arachne gained for her workmanship made her very vain and presumptuous, so that she at length ventured to challenge the goddess Minerva to a trial of skill with her. Now Minerva happened not only to be the goddess of wisdom, but was also the patroness and inventress of all sorts of needlework as well as of spinning and weaving, and, as might be supposed, was very clever herself, so that when she tried her skill with Arachne the latter was beaten. So mortified and ashamed was then Arachne at this defeat, that she went and hanged herself on a tree in her despair, and the goddess in pity at her fate changed her into a spider, in which form she was still to go on spinning and weaving.

We thus see how it was that the Spinner and Weaver of our gardens was first called Arachne by the Greeks, and why his descendants are now called Arachnidæ; but it may be that this story was invented very long ago to account for the cleverness of all the family in spinning

and weaving, and that the Greeks were so proud of the skill of men, that when they saw a tiny creature able to spin fine and delicate threads and weave them into beautiful webs, they said in their pride that it could not have been so clever if it had not once been a human being, and thus they invented the story of Arachne.

But truth is much more wonderful than any stories. and ought to be more interesting to us, so putting all such aside, we will see how we can describe the wonderfully formed body and still more wonderful powers and curious ways and manner of life of the spider, a creature whom we all see so often without seeing well, and whom instead of admiring for the patient industry with which it exercises its skill for the gain of its livelihood and the care of its offspring, are too apt to consider in the light of a nuisance, all because of those webs of theirs. they not hang them in the corners of our rooms where they catch the dust and look most unseemly, and across our window panes where they obstruct the view, and from bush to bush in our gardens, so that they come across our faces and get entangled in our hair as we pass down our paths? They plague and annoy us, and we brush them away with impatience and disgust, and yet when we observe these webs and their weavers more carefully, and read and learn all that has been observed and discovered about them by others, we find that we might perhaps spend a life-time in watching and examining them, and yet not be able to discover all that is puzzling and difficult to understand in the webs themselves, and in the lives and ways of the creatures who weave them.

And to begin with the curiously formed body of the spider, all the parts of which can only be seen with the help of powerful magnifying glasses and microscopes. There are, of course, many kinds of spiders, but we will confine our description to those we have the best opportunity of seeing, and more especially to the one who generally lives in our gardens and is best known to us. We all have seen its round body—round as a nut; its head and eight slender, many-jointed legs, with which it runs to and fro upon the threads of its web with the grace and agility of a rope-dancer, and which perform the part of arms as well as legs, as their owner weaves its web and captures its prey. We must use the microscope to find out the other parts of the body, such as the eight eyes placed on the top of the head; the strong pincers on each side of the mouth, which are not unlike the claws of a lobster, and are used as weapons in seizing and devouring its prey; and, lastly, the spinnerets beneath the body—a number of small bags of gluey matter, covered with thousands of minute hairs, which are really little tubes, out of which the creature squeezes the material for its thread, and which issuing from its body like an exceedingly fine spray or shower of liquid, becomes dry and firm and elastic on coming in contact with the air, and unites together, forming one fine thread, which we can just see without the help of a magnifying glass. We know that thousands of fine fibres of hemp make up a strong rope, and that it is all the stronger for being made up of many such fine threads or *strands*, and so it is with the spider's



transparent rope, which holds together so wonderfully as long lines of it are hung from tree to tree and from shrub to shrub, and when it is carried round and round to form one of the wheel-like webs. The microscope



shews us the curious claws at the ends of its fore-legs, with which it adjusts the thread as it spins it, and which it uses to hold its prey as it binds it round with

² Spinneret of Spider from a magnified Photograph.

bandages of web-thread to secure it. All these parts of its body—the eyes, claws, pincers, flexible legs, and spinnerets—supply the small creature with just the instruments wanted for the exercise of its powers. The eight eyes help it to see its prey, and escape from danger itself in case any bird should attempt to capture it. The spinnerets produce all that it wants when the curious sense within it which we call *instinct* sets it to work to spread its fly-nets, which hang in the corners of our neglected rooms and among the shrubs and trees of our garden. The strong pincers, called *mandibles*, at the front of its head, which enable it to clasp its prey, are also furnished with little reservoirs of poison, with which it can stupify or kill a fly that is too strong for it to overcome.



HEAD OF SPIDER.

We wonder at the regularity of the spider's web and at the accuracy with which all the circular threads are kept

^{*}Aperture by which the poison issues.

exactly the same distance apart, and if we watch it when weaving we shall see that one fore-leg is employed to guide the thread and keep it just the right distance from the last thread woven, acting as one of the legs of a pair of compasses and a lady's crotchet needle at the same time. It is a curious fact about these spider's webs that they are made of two kinds of thread, spun, it is supposed, from different spinnerets. The thread used for the spokes of the wheel, or warp of the web, is a fine elastic, glossy thread, dry to the touch, but the thread with which the spider makes its circular woof comes from the body sticky and gummy, little globules of gum being visible (when magnified) along the thread like tiny beads

With this supply of gummy matter, the thread, when laid along the spokes, adheres to them, and never seems to get detached, and it is likely that the stickiness of it helps also to catch and entangle the flies. The spider is very careful to keep its web free from dust or dirt, and can be seen going over it, very carefully dusting it with its hairy feet, like a diligent housemaid. Should by any chance a leaf or bit of straw, or chip of wood, fall upon its web and get entangled in its meshes, it will instantly issue from its private apartment up in the corner, where it is accustomed to sit as in a watch-tower, and coming down to the intruding object, will carefully disentangle it from the web, so as to let it fall to the ground, without a single thread being broken or displaced, while if we had tried

to extricate the same object, our clumsy fingers might perhaps have caused a large rent in the web. Very curious, too, is the manner in which a spider, when a fly is once caught, will pack its wings around it, and bandage them up with web thread, so as to quite prevent the possibility of their being used for escaping. case the spider, in capturing its prey, stupifies it with a drop from its poison bag, and when thus rendered helpless and insensible, it drags its victim behind it with a short thread fastened to it, as a sailor would a boat with a towing rope, and thus hauls it into its larder, which is always some corner from which it can watch its web. Even a butterfly, eight or nine times the captor's size. will be rolled up in its own wings and rendered as shapeless as an Egyptian mummy, in order to be portable and compact enough for being stowed away for future consumption. One thing is very certain, that a spider must eat if it would keep up its stock of material for web spinning, since that results from the digestion of its food, as does the shell of the snail and the silk of the caterpillar. A good meal up in its larder is needed for supplying its spinnerets with the matter which forms the thread spun from them. The spider must feast one day in order that on some future day, in case its web should be destroyed by any accident, it may be able to begin its work over again. We can easily see spiders catch and dispose of their prey, but it is not so easy to detect all their methods of web making, and especially how it is that they are able to extend long lines of web-thread

from objects at considerable distances one from another. It would seem as if spiders meant to keep some of their doings a secret from us, since they usually construct their webs and stretch out their long lines either late in the evening or very early in the morning. If we pass down a garden path after twilight has come on, we may find a spider's line of web come across our face, where we had met no such annoyance in the bright daylight, and as we walk in the garden in the early morning we may observe that many a line has been extended from bushes wide apart from each other, and may puzzle ourselves to think how these delicate suspension bridges have been formed. We may even ask ourselves if the spider, when it wants to have a line carried to some particular point at a distance, can manage to make friends with some bee or butterfly, and get him to carry it across for it as he flies; but no! we may be certain that the creature has some power of its own which enables it to overcome the difficulty. Now all who have studied the ways of spiders are agreed in saying that they have the power of ejecting their web-thread from their spinnerets to a distance, and have fancied that the lines of cobweb we find in our gardens have been first sent out by the spiders, and then floating on the air have caught to objects and have then been used as bridges, and strengthened by additional matter by the spiders as they passed along them. may sometimes be the case, but it is also certain that to serve its purpose lines are often attached by the spider intentionally to particular spots or objects at a distance.

and that it means to have them fastened there and nowhere else, so that we are obliged to suppose that a spider can send forth a line of web with such force from its body that it will adhere to a distant object, or that, trusting itself to be supported and carried by a current of air, it can dart across to some spot, after first fastening a line to the place from which it starts, and then lengthening and spinning it out as it goes.

We have seen both these feats performed by some tiny house spiders which we had only just extricated from the cocoon in which they were hatched. They had been laid on a book and then placed on a mantel-piece; and before many minutes had elapsed after their entrance upon life, they sent up lines of the finest web from their spinnerets to the edge of a vase about ten inches high, which happened to be near them—first ejecting the line, and then travelling up it and carrying a second line with them, and coming back with a third, and so on; up and down the little creatures working, until a beautiful band of silvery web was formed between the book and vase. and then they seemed to rest from their labours and wait for prey. There were, however, no flies to be caught, so that by-and-by, when the door of the room was opened and a current of air set in towards the fire-place, the spiders one after another moored themselves to the edge of the vase, and launching themselves forth into the air like little kites, and lengthening their lines as they went, mounted to the ceiling. There it was they knew they must weave their webs if they meant to catch flies. These new-born spiders were only one-tenth of an inch in length, and the length of the web-lines sent up to the edge of the vase being quite ten inches long, it proved their power of ejecting lines 100 times the length of their own bodies, and of fastening them where they wish.

In every case a spider glues the end of a line that he attaches to an object by pressing its spinneret against it, and such fastenings when they are magnified show us the numerous finer threads of which the lines are composed.



After we have explained as much as we can about the methods of spiders in forming their webs, there is much to be discovered by any who may observe them carefully at their work, and it is when we make observations for ourselves in the ways of such creatures as the usually despised spider, that they become to us a source of interest and pleasure. We therefore recommend our readers to try to get a sight of a spider in the act of weaving its web some damp early morning in autumn, when it is about to hang it in an angle of a garden wall, or across the corner of a doorway, or between two shrubs. In every instance it will be found that an angle is wanted, within which the wheel is constructed, so that in the case of hanging a web between two shrubs, two long lines are first ejected, forming an angle and serving as a frame for

it. They may then find out for themselves how the spinner and weaver manages to get these spokes of his wheel cross so exactly in the centre, and be stretched from point to point so firmly and yet so lightly, and see how cleverly as he runs round with his line he manages to keep it at such accurate distances apart, by letting it pass over the claw at the end of an outstretched leg, and how each time the circular line crosses one of the spokes it adheres to it—all this and much more may be seen by those who give sufficient attention to the ways and doings of spiders, and pay respect to the wonderful powers with which their Creator has gifted them. When we cease to think of a spider only as an annoyance or a nuisance, perhaps then the clever creature will allow us to discover some of its hitherto undivulged secrets.

Some of the ingenious methods of the female spider for preserving her offspring have already been discovered, and are most curious. The time comes in her life when she wants to lay her eggs, and of these she lays an immense quantity, so that her race may be kept up, in spite of the numbers eaten by birds and other larger creatures, and for this reason the eggs are to be taken great care of, until the germ of life in each shall be ready to unfold itself into a young spider—or, in other words, we may say that the mother spider takes care to place her eggs in a place of safety until they are hatched. Will it be thought that we are inventing, when we say that the careful creature contrives to provide an egg-cup for holding her eggs in before she lays them, and that her body is

furnished with a tiny egg-spoon, with which she places each egg in its place? Such, however, is the fact. We know that at all times the spider has within her body an abundant supply of the material for spinning her fine elastic thread, so that when she requires a nice little cup or basket for her eggs she has only to spin thread and then to weave it. Choosing some sheltered nook for her operations, she begins the construction of her nest by weaving the bottom just as a bird constructs first of all the bottom of his nest, and the basket-maker the bottom of his The spider, while sending out the silken thread from her spinnerets, has only to move her body round and round, and a nice little mat is formed of the sticky web-thread, and then making her round body serve as a kind of mould for the nest, she goes on spinning and turning round as she spins until sides to the cup are raised high enough to hold safely a number of eggs. This done, the eggs are laid, each one being carefully placed with the help of the kind of spatula, or flat spoon, which is attached to the end of her body. This instrument is often called an ovi-positor or egg-placer, and in some insects is very long, but the spider does not want a long one. When the cup is even full to the brim with eggs, she still goes on piling them up until as many are above the edge as are within the cup, and then commences the weaving of a cover to the egg-cup, and lastly she encloses the whole in an envelope of fine web closely woven around it, until it becomes like a soft ball of silken floss, of a pale yellow, within which the numerous

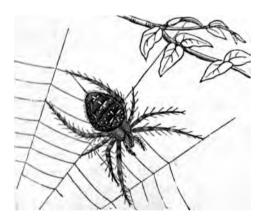
eggs are kept dry and warm through the winter. cocoons may be seen in spring the young spiders already hatched at one end and the empty egg shells at the other, the former waiting perhaps for suitable weather for coming forth and entering on the business of spider life; and when not larger than a mustard seed young garden spiders will set about weaving tiny wheel-shaped webs for the capture of flies still smaller than themselves. After laying their eggs, some species of mother spiders have no more to do with their young; but others seem never to lose sight of their ball of eggs until the young ones are hatched, and if they have to change their place of abode will carry it about with them; and some others seem to take care of and feed their young ones after they are hatched, and will let them climb on their backs to escape from danger.

The manner, too, in which some species of garden spiders entrap and capture their prey is quite different from the one which makes a wheel-shaped web, or from 'the house spider who hangs its gauzy web across the corners of our rooms, which are invisible to us until the dust settling on them makes them look like dirty bits of rag. Some, who are dwellers in our garden, construct for themselves long tubes of close-woven web among bushy shrubs, spread out wide at the top like a trumpet, and carefully secured by lines to the leaves and twigs. At the bottom of this, the spider lives watching and waiting until some unhappy fly gets entangled up above. A sort of vibration passes down the long passage from

the struggles of the fly to escape, when quicker than a railway train can dash through a tunnel, the spider darts up to seize its prisoners. Other kinds of spiders in our gardens live in holes and crannies in walls and trees, which they line with web, and only dart out on their prey when they come near the mouths of their dens. These creatures, called Tegenaria, are very fierce, and have very long legs in proportion to the size of their bodies, so that one of the kind goes by the name of Daddy-long-legs, and is known to most of us by those long and graceful legs. It is sometimes said that spiders will kill and eat each other, but we like to believe that in such cases the victims are captured in honourable warfare. A spider, for instance, has been seen to invade the web of another, and seat himself in the centre, trying to appropriate it to his own use, and the real owner has come out—as if in the defence of his castle—fight and wrestle with the intruder, and after killing him, eat him up as if he were a fly. It is also said that the female spider will sometimes kill and eat a male spider when she does not take a fancy to him—the female being much larger and stronger than the male-but we are not sure of the truth of such stories, though we are afraid that our clever Spinner and Weaver has after all a good deal of the nature of a beast of prey. In tropical countries species of spiders are found which are nearly as large as small birds. The bodies of some are covered with soft and glossy brown fur, like the sealskin we use for jackets and gloves. Some of them live in holes in

the ground, which they line with web and protect with a trap door, which opens and shuts with a hinge; others, such as the great Mygale spider, which is not unlike a hairy crab, makes its nest in the cavities in the trunks of trees, and is said by travellers to prey on newly-hatched birds, and even to capture and eat the lovely hummingbirds which flit among the leaves and blossoms, and are scarcely larger than itself. Spiders are so often called insects that we are apt to forget that they cannot be classed with bees, butterflies, and beetles for several reasons, but form quite a separate race of creatures. The structure of their bodies is unlike in many important particulars, and they do not pass through the same changes as do all insects, as we shall describe in our next chapter. A spider is, in fact, a nearer relation to crabs and lobsters than to bees and butterflies. As the spider grows larger and larger, it casts its skin many times, and each time a new one is ready formed beneath. From being at first scarcely so large as a grain of mustard seed, the maker of the wheel-shaped webs in our gardens sometimes grows to be as large as a small nut. had the grand name of 'Epeira diadema' given to it, and a grand creature it really seems when grown to its full size, as it sits in the centre of its splendid web and allows us to examine its form. We see that its back is most curiously mottled and spotted with white and black, and that it has something like a white cross on the top of the back. With an ordinary hand magnifying glass we can see the eight bright eyes which form a kind of diadem upon the head, and which have given the creature its second name. We may also contrive to

see under its body the bunch of spinneets, from which comes forth the web
material through the fine hair-like tubes
which are called spinnerules, and can just detect the
claws at the ends of the legs, which are such useful
implements in the adjustment of the circular lines of the
web, or in hauling itself up again after having dropped
down from a height. Seeing thus its curious body, and
having learned something of the wonderful powers which
have been bestowed upon them, we can surely never
look upon the Spinner and Weaver of our gardens with
either dislike or contempt, for according to the life that
was meant to be his, are after all, his seemingly cruel
ways, as well as his clever works







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CHAPTER III.



IFE THE FIRST.—This life begins when a little worm furnished with sixteen legs comes forth from an egg just large enough to hold it, and the whole life is spent in feeding on the leaves of the plant upon which

that egg was laid. From being scarcely visible when first hatched, the small creature, as it eats, grows so rapidly that in twenty-four hours it has increased to four times its size when it first left the egg, and it is soon large enough for us to see its form and parts. We can see that six of its legs are for crawling with, and are



placed under the fore part of the body, while the other ten are only for clasping the leaf on which it feeds, or the stems of the plant on which it crawls. It has a horny covering on its head, jaws for biting, eyes for seeing, and *spiracles*, or breathing holes, down each side

Its skin is soft, and adorned with delicate of its body. stripes or spots—sometimes it has fleshy spines, sometimes it is hairy, and sometimes the whole body is covered with dark brown fur. As it eats and grows larger and larger, it requires a new skin to fit its increased size, the old one shrivelling up, and the new one appearing beneath. Many times in the course of its life is this done, and then, having grown to its full size, and as if tired of this mode of life, it crawls down the stem of the plant on which it has fed, makes its way to some wall, or paling, or tree-trunk, and climbs up it to some sheltered cranny or corner, there to await a complete change in its form and life. At this time the creature begins to exercise in a new way the power it has always had of producing from its body a silken thread, by which it could let itself down from a leaf or twig at will. It now spins fine cables of this silk with which to fasten itself in safety to the resting-place it has chosen. Unlike the spider, this silken thread is spun from its head, and managing to pass a belt of it round its body, it fastens the ends of it to the wall or paling, or to some twig in a sheltered place, so that it cannot be blown off, and with another thread suspends itself head downwards. Other creatures of its race fasten themselves to the stem, or roll themselves up in a leaf of the plants on which they feed, by means of these silken threads, so as to make a little cradle or nest; others weave together some of the smaller leaves of their native plants, and make a sort of cage with web, in which they suspend themselves. Others will fasten

together the ends of some blades of grass, so as to form a little tent, in the middle of which they hang themselves by a silken thread—all these preparations being made for the creature passing through a change in its form and nature, and ceasing to be what we call a caterpillar.

LIFE THE SECOND.—During this life the soft body has acquired a hard skin or case. It is mostly dark or shapeless. It no longer eats or moves from its place. It has neither eyes nor mouth, for it has no need of either, nor has it any feet or claws,

and the only sign of life it gives is that of being able to bend slightly its horny case or shell, which at the tail is jointed like that of a lobster. It is mostly brown

or bronze colour, but it has sometimes golden stripes upon it, or is wholly gold coloured. Now the Greek word for gold is *chrysos*, and from this it has come that the name of *chrysalis* has been given to this stage of the creature's life, which when it crawled about and ate, was called a caterpillar. A pitiable sort of life would it be if chrysalis-life were all—but better times await it. We have said that the chrysalis is shapeless, but if we examine it more closely we shall find that in the curious angular body slight traces of parts are visible. They show that there is something carefully packed and folded up within the case—something which is soon to be unpacked and unfolded. Only a little more time and a little more warmth, and the changes which

are going on within the brown or golden case are completed, and another form of life begins.

LIFE THE THIRD.—The summer's hot sun shines day after day on the little mummies upon the garden wall or paling, or which hang in the tents or little bowers formed of the tender leaves or twigs of plants. It has ripened, and brought to its most perfect form the life now about to begin. The hard and brittle case which was its second form splits open like a ripe seed vessel, and from it comes out the bright and graceful creature

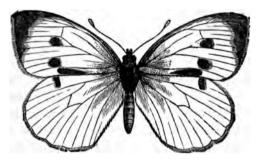


we call a butterfly. A creature gifted with eyes to see with, antennæ to feel with, proboscis to feed itself with, legs to crawl with, and four light and lovely wings to fly with. When first it comes forth from the coffin-like case which held it, the delicate wings are crumpled up and shapeless, covered with the damp of its late tomb; but no sooner is it in the soft warm air and free, than the life-juices begin to circulate in its veins, and gradually the wings are straightened out and spread. From time to time a sort of shiver seems to run through the frame as this comes about. The long trunk which lay along the under part of the body is drawn up, and gently coiled

into the place for it under the head. It seems but a fine thread this proboscis, but it is really a tube, for henceforth the life of the creature is to be supported, not by eating the leaves of plants, but by sucking up through that long tube the honey of flowers. At last the wings are expanded to their full size and form. Their delicate veinings and pretty markings are to be seen. White or vellow, with black spots and veins-red bands-orange tips—patches of brown velvet—borders of brilliant blue -scolloped edges and slender points and angles-all the beautiful varieties of pattern, colour, and outline, according to their kind, are visible. A gentle trembling seems to shake the wings, as if the creature were impatient for flight; and then a flutter, and at last it suddenly mounts into the air, and is gone! gone to enjoy the warm sunshine, the soft air, the enticing flower scents, and delicious and delicately-flavoured nectar, now out of this flower and now out of that-honevsuckle. rose, jasmine—through the live-long day.

The coming forth of the bright winged butterfly from the seemingly lifeless chrysalis has often been looked upon as a likeness to the spirit of a human being leaving the body at the moment of death; but though the manner in which the life of this and every other insect passes through such curious changes, is most wonderful and most mysterious to us, it does not really help to strengthen our hope of an immortal life, since the chrysalis is not dead, and the butterfly only lives to lay its eggs and then die. The ancient Greeks, however, looked

upon the butterfly as a type or emblem of the soul, and gave it the name of Psyche, which was the Greek word for soul or spirit, and at last the emblem of the soul came to be represented by them, in painting and sculpture, as a beautiful young female with the wings of a butterfly.



PIERIS BRASSICÆ, OR CABBAGE BUTTERFLY.

Among the many butterflies which flit about our gardens during spring, summer, and autumn, there is not one which is so sure to be a dweller there as the species whose common English name is the 'Cabbage Butterfly.' Few gardens are there which do not grow cabbages, and this creature may be said to be born and bred upon cabbage leaves. The strange foreknowledge which we call instinct, led the parent butterfly to deposit her eggs on the large and succulent cabbage leaves, which, when they are hatched, are sure to afford ample food for the caterpillar through the whole of its life. It need never leave the plant. When one leaf is eaten up all but the

veins, it has only to move to another, and then go on munching again with its horny jaws, which, for the convenience of leaf eating, do not move up and down, but backwards and forwards sideways, like pincers or shears.

The egg out of which the caterpillar comes is seen when highly magnified to be of a most beautiful form, somewhat like a flask or bottle, delicately carved with ribs and furrows and fretwork. The caterpillar when full-



grown is a blueish grey colour, with yellow stripes on each side, and the whole body is spotted with minute black dots, with a white hair in each dot. When we see the devastation which can be done to our cabbage plants by these caterpillars, and when we hear of the number of eggs sometimes laid by one butterfly on a single leaf, we may wonder that any cabbages at all are left for human beings to eat, but this is easily explained, for caterpillars are the chief food of many young birds. When a sparrow, for instance, has a nest full of young fledglings crying out and gaping for food, it has only to repair to the cabbage



CHRYSALIS AND CATERPILLAR OF CABBAGE BUTTERFLY.

plants in our own or a neighbour's garden, and can at ease pick off all it wants of the soft savoury creatures that its young require for their nourishment. It is said that a parent sparrow will sometimes carry home to its nest as many as two thousand caterpillars in one week. Insects, too, prey on them, as the ichneumon fly, which will lay its eggs in their bodies, and the eggs being hatched there, the *larva*, or fly-grub, will gradually eat



VANESSA IO (PEACOCK BUTTERFLY).

up the body of the caterpillar, who still goes on eating until nearly the last spark of life is left—the grub itself taking care to avoid the more vitai parts of the caterpillar, so that its own food supply may be continued as long as possible. When the caterpillar by chance escapes being captured by a bird or being preyed on by the ichneumon fly, it hangs itself up, head downwards, to the garden wall or paling, or to the branch of some fruit-tree, and turns to an angular black-spotted chrysalis, fastened round the body with a belt of silk.

The Cabbage Butterfly of our garden, however, is a very common and homely looking insect, compared to others which live on the honey of our flowers. We have there, flitting about in the sunshine through many months of the year, first one and then another of some beautiful sister butterflies, having the same family name of Vanessa, but who are distinguished one from another by second names, such as 'Io,' 'Atalanta,' 'Cardui,' etc., and by the English common names of 'Peacock.' 'Red Admiral,' 'Painted Lady,' and 'Tortoiseshell,' etc. Most lovely in form and colour are these sisters; their wings being not only very elegant in outline, but adorned with spots and stripes of blue, black, and white, and with bands of red on a velvety ground of rich brown, all three somewhat alike and yet very different and easy to be distinguished one from another. We cannot claim all these as natives of our garden, though they are so often seen there, for, strange to say, these gay creatures, who are so bright and delicate, and might be supposed to have been born and bred among our choicest flowers, are really natives of some neighbouring bit of common-land or waste ground by the road side. There the caterpillars have been hatched from eggs which were laid on the leaves of the nettles and thistles which grow in such places, and after the caterpillar has fed on these leaves until it is ready to take the chrysalis form, they still remain on the plant. Constructing themselves little cages or tents, partly of the stinging and prickly leaves of the plants, and partly of silken webs and threads which draw

them together, they there undergo the curious change. A few weeks is sufficient time for them to pass from the newly-hatched caterpillar state to that of the perfect butterfly.



CHRYSALIS OF VANESSA URTICA, or 'of the Nettle.'

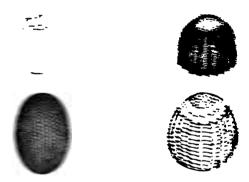
When once escaped, however, from the little angular mummy-case suspended among the thistle and nettle leaves, with their wings ready for flight, and their long trunks ready for suction—then it is that the Vanessa sisters



VANESSA URTICA (TORTOISESHELL BUTTERFLY).

The road-side nettle has no food that become ours. will suit their newly-acquired taste for honey, nor has the thistle, with its closely packed tuft-like flowers, so they come over our garden walls to us. They depend upon our flowers, and flitting from one to another, poise upon their expanded corollas, and gracefully unfolding their coiled-up sucking tubes, dip them down to the nectaries of the flower cups and bells. They can get at honey which the short proboscis of the bee cannot reach, as well as at that which is at the bottom of flower tubes too narrow for the entrance of the bee's body. Only when the time comes for providing for the continuance of their beautiful race, do they go back to the nettles of the road-side, or the thistles of the common, in order to deposit their eggs on the same sort of leaves that in the caterpillar form had served for their own nourishment. Does some curious remembrance of what their former life was, among those nettles and thistles, guide them back to them; or do they know that there, among the stinging and prickly leaves, their eggs will be safe from the disturbance of human hands? Does some fairy whisper to them that there their offspring will be safer than among the buds and blossoms that those human fingers are so apt to meddle with? We only fancy this, for we know that they are but led by the unerring instinct which seems sometimes to guide these small creatures more safely and surely than human beings are always guided by the reason of which they are so proud. And these eggs, which to our unassisted eyes would appear

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In the East, myne magnified.

out to torquent at the view there in the interior to forms of the view there easy are intrincial. The Francisco tortical took through her second name does made, of the notice will be second name does made, of the notice will be a size thread hereafth the topping where it a garden wall for the sake of its shelter, and Wannessa cardui,' or 'of the thirdle,' if she find out that we have artichokes in our kitchen gardens will lay have easy upon its spiked leaves, and the caterpillar, after

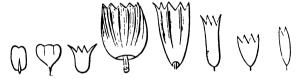
feeding on these, will, when it comes to the time for changing into a chrysalis, construct a little tent of them, drawing together the smaller leaves with silken cords, so as to make a safe shelter, and thus causing the entrance into life of the beautiful 'Painted Lady' to be within the confines of our garden walls.

Butterflies are not only very beautiful, but are also very curious creatures; as we find when we help ourselves with the microscope in order to examine them more carefully, and from the moment that the caterpillar has left the egg there are to be found traces in their structure of what we may call a preparation for the perfect form of the butterfly, which is little by little arrived at as it grows and passes through its first two stages of life. It is no wonder that the caterpillar should feed so ravenously. since it is nourishing itself in order to provide material for the other forms into which its life is to pass. Careful naturalists who have dissected and magnified very highly the insides of caterpillars have discovered in their bodies signs and tokens of what was to be afterwards the butterfly's wings. In the chrysalis they can see it still more plainly. But we need not so much wonder at this, because it is what we find in all animal and vegetable life and growth. All the forms of life have small beginnings, hid as it were in other forms. From an egg the size of a cocoa-nut comes the great ostrich—from the small acorn the mighty oak, with its wide-spread branches, its solid trunk, and millions of leaves. Something in the egg becomes the future bird, and something in the seed

becomes the future tree or plant; and in the same way, something in the caterpillar becomes the future butterfly. Even if we cannot see them, we may be sure that such parts as the delicate feelers with the knobs at the end, which are probably the organs of scent, as well as the long proboscis, are in preparation from the first, though neither caterpillar nor chrysalis has need of them; and the lovely wings which make the butterfly such a different creature to the soft and crawling worm or the shapeless chrysalis, are also there, hidden in the caterpillar. Only one thing is alike in each of the three forms, since in all are found the spiracles, or small breathing-holes, down each side of the body, through which the air is inhaled which is essential to the continuance of life.

Like many other insects, butterflies have two large eyes on each side of the head, which are fixed and immovable—not turning in every direction like our own eyes in search of those objects we want to see, nor like our eyes in admitting light by one aperture, but composed of innumerable little eye-lets, or facets, which perhaps reflect objects like tiny mirrors. Such eyes are called compound eyes, and no doubt perfectly suit the purposes of the butterfly during its short life, when a few flowers holding a drop of nectar, and a leaf or two of the right sort to lay its eggs on, are all that it has to look out for.

We must all have noticed that if we attempt to hold a butterfly after we have captured it, a fine flaky powder comes off on our fingers, which we have perhaps been told as children was the feathers of the butterfly's wings. But this is scarcely the fact, for when highly magnified, it is found to be composed of coloured scales, rather than feathers. In each variety of butterfly, these scales somewhat differ in form or texture, and are found to be placed on a gauze-like frame-work, one lying on another like tiles on the roof of a house. Those on the under side of the wing being often different in form to those on the upper side.



SCALES OF BUTTERFLY'S WINGS, highly magnified.

The motion in the wings of butterflies is very different from that of birds, from their not moving both wings at the same time. They do not rest in the air, nor swoop, but flutter up and down in a zig-zag, which manner of



flight is perhaps a safeguard in some respects from capture by birds, and enables them to elude their pursuit.

The slender antennæ, or feelers, which every butterfly has on its head, are found to be jointed or movable, so that they can be bent slightly; but whether asleep or awake, they are always erect, and not like those of the moth when asleep, bent back over or under the body.



HEAD OF VANESSA ATALANTA, OR RED ADMIRAL BUTTERFLY, showing the two feelers, the large compound eye, and the proboscis unfurled.

The structure of the proboscis, or trunk of the butterfly, is very curious. When the perfect insect first comes out from the chrysalis's case, it is extended along the stomach, and while the wings are being gradually expanded into their full form and size, it is disengaged and rolled up into a spiral coil. It is formed of two long blades, each hollowed out in a furrow, and after first one

is drawn up and then the other, the two portions are put together, and form a double tube most delicately jointed, so that when wanted by the creature, it can be gracefully uncoiled, and dipped down into a flower, no matter how deep its tube or bell may be; and in this respect the butterfly has an advantage over the bee, since it is enabled, as we have seen, to take possession of honey which the short proboscis of the latter has not been able





FORE-LEGS OF CATERPILLAR.

HIND-LEGS OR CLASPERS.

to reach, or which lay at the bottom of flower-bells and tubes that his body could not get into in order to rifle. The six or four slender and jointed legs of the butterfly are very different to those of the caterpillar, in whom the six fore-feet are furnished with pointed claws, which assist it in weaving and adjusting the silken thread which comes from its head. After letting itself down by a line, to break its fall or escape from capture by birds, it uses

these to haul itself up again. The other ten legs are called claspers, their use being to enable the caterpillar to cling tightly to the leaf or stem of the plant on which it feeds, and when magnified are found to be like suckers, which adhere by means of the air being excluded beneath them; and as the fly can walk on the ceiling by means of such suckers at the end of its legs, so can the caterpillar hold itself on to the under side of a leaf. When it is spinning the silk thread which comes from its head, or weaving a web with it, or passing a belt round its body when about to change to a chrysalis, these claspers hold it securely fixed to some object.

The casting off of the skin several times in the course of the caterpillar's life is very curious, and during the operation, the creature leaves off eating and looks sick and ill, and the old skin shrivels up. When gradually it is wriggled off, the new skin beneath appears smoother in texture and brighter in colour than the last, and the caterpillar seems altogether larger, as if the new garment were not put on before it was wanted. The change of skin of the caterpillar is like the moulting of birds, and the growth of fresh hair over the bodies of quadrupeds.

It would seem that in some respects the different species of butterflies often differ from each other in habits, although belonging to the same family. This is especially seen in regard to the manner in which they pass the winter, or hybernate. In order that the race of each should be continued from year to year, one of the forms of their life must last through the cold of our

winters, and in spite of their love of warmth and sunshine, and seeming dependence on flowers, we find that it is often the butterfly which survives. When the cold days of autumn come on the butterfly will fold up its wings one against the other, slip into some crack or cranny in a wall, or paling, or tree trunk, and there in a state of lethargy or sleep await the return of spring. A very fine warm day, even as late as the end of November, or beginning of December, will waken up some of them



from their winter sleep, and entice them out to see if such a thing as a honey-holding flower-cup is yet to be found. With other species it will be the chrysalis which lasts through the winter—the butterfly coming forth from it with the earliest sunshine of spring, while some very few eggs of the caterpillars will remain on withered leaves, or on the stems of plants, and be hatched in spring by the same warmth which has brought out the young leaves they require for their food.

We cannot attempt to tell of all the lovely butterflies which, during the summer months, will from time to time pay visits to our gardens, from their different native places—all of them being so free to rove, that no wonder they venture sometimes on a little foreign travel. They come to us from sweet meadows starred over with buttercups and ox-eye daisies, and reddened with spikes of flowering sorrel—from banks where dog-violets hold up their blue flowers to the sun, and primroses nestle



ORANGE-TIP BUTTERFLY.

among their leaves. They come from fields of clover and beans—from river banks, where reeds and rushes, and willow-herb grow so tall, and are all alive with insect life. Others come from shady woods and copses—others from heaths covered with ling and purple heather, and golden broom; and from commons where the luscious-scented gorse is flowering, and others from chalky downs where the tiny eye-bright and milk-wort and dwarf bed-straws grow among the short grass. When we happen to

know where they come from, they remind us of these sweet native homes of theirs, where they have lived their two former lives. They give life and colour to our gardens, and cause us pleasant surprises as we find the pretty phantoms there among our flowers, and though we do not always remember it, they form one of the charms of our summer days. We do not quarrel with them, as with the snail and spider, because they so please our



CHRYSALIS OF ORANGE-TIP—placed on bough so as to look like part of it.

eyes; but somehow we hold them a little in contempt. We think of them as frivolous and thoughtless of the future, and consider them unworthy to be compared to the careful and provident bee or ant, just when they are leading the life they were created to live, and doing as their natures prompt them to do. Ought we not rather to remind ourselves of the tender forethought which leads them to lay their eggs only where the right kind of food will be supplied to the young caterpillar the mo-

ment it is hatched; and more than this seems to determine many of them in the laving of their eggs. The care shown by one butterfly alone, for instance—the 'Colias Hyale,' or 'Pale-yellow-clouded' Butterfly—ought to redeem the whole race from the charge of frivolity. Instinct leads her when the time for depositing her eggs comes in the early summer, to lay them on the delicate leaves of the clover or trefoil. The egg is hatched, and the small caterpillar not only feeds on the leaves, but finds in them a protection from cold and damp. leaflet of the trefoil has a way of folding itself up-onehalf of the leaflet against the other half, when night falls. The little caterpillar has, therefore, only to stretch itself along the mid-rib of the leaf when the sun has set, and then the leaf folding itself up, and its toothed edges clasping closely together, the tender body of the caterpillar is enclosed within a soft cradle during the hours of dampness and cold; and when the sun again rises and expands the clover leaf it may begin to eat its couch for its morning meal! We like to give the 'Colias Hyale' some credit for obeying so carefully the promptings of her nature; but we must also remind ourselves of the Beneficence and Love which has given to her nature that forethought which is so tenderly to secure the preservation of a little caterpillar's life. To each creature has been given, by its Creator, either a desire to provide beforehand for its young, food and safety, or the means of protecting it when born; and at the same time there is given to it the sort of knowledge which is needed to satisfy the desire, as well as for the employment of the means of protection.



VANESSA CARDUI ('of the thistle')-PAINTED LADY.

CHAPTER IV.

UNDERGROUND DWELLERS AND WORKERS.

OST curious and yet most true is the story we have to tell of how while we walk about our gardens, treading our gravel paths and cross-

ing our grass plots and lawns, there is living and working beneath our very feet a race of small creatures whom we may describe as a people who dwell in large communities underground, and who inhabit cities formed of caves instead of houses. At times we see very little of the inhabitants of these cave-cities above ground, but in the early part of the year, a portion of them being employed in forming fresh underground dwellings for the use of their increasing population, we can perceive the situation and extent of their operations by the piles of earth which are thrown up to the surface of the ground, and which also enable us to judge of the great works going on beneath. When we consider the proportion that these earth-works bear to the workers, we may well call their labours most wonderful, especially as they are performed without the help of machinery or even tools. At the beginning of summer we may find thrown up on our lawns piles of earth which

are as enormous when compared to the size of the workpeople, as were the great pyramids of Egypt to the men who constructed them, and even on our paths are to be seen piles of gravel like small craters around the openings of the shafts, or passages which lead down to the excavations underground, which are as high when compared to the excavators as are our houses to their inhabitants. Now if we watch how these mounds of gravel are raised, we shall see that there are two streams of busy workers constantly going up and down the shafts; one stream consisting of workers who come up with small loads of earth which they carry to a short distance from the entrance to the shaft, and another stream of those who are returning to fetch more; and if we examine with a magnifying glass these tiny loads of earth or gravel, so small to our eyes, but yet a heavy load no doubt to the creature who carries it, we shall find that it is a rounded ball of soil which has been slightly kneaded together before it was brought up; and should we attempt to count these small loads of earth, we shall find it impossible to number even those which are around the entrance of a single shaft, and yet each of them represents the toilsome journey of a worker from beneath to the surfacehundreds of thousands of small grains, telling of hundreds of thousands of journeys up and down; and when we observe all these signs of labour we may be sure that at such times is going on, the construction or enlargement of one of the cave-cities of the Underground Workers.

Let us, however, see what is the form of the little workers, and what are their powers; and again using the magnifying glass, we now perceive that they have curious long bodies divided into three parts, that they have six legs, and two long feelers in front. The head, the chest or thorax, and the stomach or abdomen, form the three parts, and it is this division of the body which causes the creature to be called an insect, and we know that this particular kind of insect is called an ant. all get some notion of the busy bustling fussy ways of ants from what we see of them above ground, but it is by no means so easy to find out all that relates to their lives beneath the ground. Curious mistakes have been made about them and their habits, and after all the close observations of a great many naturalists who have made them their study, we have yet much to learn about them, while the more we know of the tiny creatures, the more wonderful their doings appear to us. Of course there are many kinds of ants, and the habits of each kind differ somewhat from one another, but in some respects all English ants are alike in their mode of life; and when we have learnt all that there is to tell about our garden ants, we shall find that the whole life of the greater number of them—just those whom we see bustling about here and there, and journeying up and down, is spent in labours that have a very important purpose.

In each ant city there are three kinds of inhabitants, and on all three kinds the good of the whole community depends. There is no such thing as an ant living

or working for itself, providing for its own wants or those of its young, as with most other creatures. All ants live and work together for the benefit of the whole population in each community. In each of the latter, there are males, females, and working ants. The males and females have to produce the young, and so supply inhabitants for the city, while the working ants have to work for, and feed, and take care of the males and females, and young, and construct the cave-cities, and it is these indefatigable little creatures with which we are best acquainted from seeing them above ground when they come up on matters of business. On them depends, in fact, the well-being and lives of all. It is they, as we have shown, who are so busy when the fine weather sets in, in hollowing out the caves or cells, which will be wanted for future progeny, and which they connect together with galleries and passages, so that all are communicable one with another. Some of the caves are for the reception of the females who are to become the mothers of a future generation, others are for the males, and others are destined for the eggs which produce the grubs or larvæ, and others for the cocoons from which the perfect ants are to be hatched. The female ants being much larger than either the males or workers, larger cells are wanted for them of an oval form suited to the shape of their bodies, and where they are waited upon and tended with great care and respect, since on them depends the keeping up of the population, which seems to be the great aim of all ant labour and industry; and when we consider how a constant diminution of their numbers must be going on from the fact that many species of birds make them their food, we can understand how necessary this strong instinct is in the nature of the little creatures, if the ant race is not to die out and become extinct. The greatest care, and exactness, and skill is shewn in the formation of the The walls of them are built up of grains little cave cells. of earth, fitted into each other with great precision, and then it would seem they are covered over with some kind of cement which the creature has the power of secreting from its body, and when the whole is done, the small mason will carefully pass his feelers over his work to see that all is smooth, compact, and firm, just as a human mason will measure his work with his rule to satisfy himself that his bricks are all level, and his wall upright.

During the winter, ants spend their time in a torpid state in their underground caves, and at this time the hive is filled perhaps only with workers, and the cocoons ready for hatching when warm weather comes, and it is to prepare for the fresh populations that new works, and additions to their cities are made in spring, and when these are once finished the whole character and employment of the working ant undergoes a complete change. The same anxiety for the good of the whole community, the same devotion to the interests of their race and city shew themselves, and the same self-denial and unwearied industry goes on, but they are now

no longer miners or masons, no longer 'navvies', but become most tender and careful 'nurses.' From the time that the city is supplied with new abodes, and that the warmth of the sun is felt even beneath the earth, the wonderful transformation begins within the ant-cocoon which is to change its contents into a living creature. Just when the mother bird is sitting on her eggs in her snug nest, so as to give the warmth needed for their change into young birds, the ant nurses begin their loving attentions to the cocoons in their caves.



ANT highly magnified, carrying Cocoon.

which also require heat for their change into living ants. More eager bustling begins among them, which we cannot always see, since it goes on beneath ground. When the sun shines out bright and warm, the cocoons in the cells deep down below in the hive, must be carried up to nearer the surface, where the warmth will reach them, and to effect this the whole army of nurses is in commotion; and if we can manage to catch sight of them at such times we shall see each little worker with a white oblong cocoon—not very unlike a baby in swaddling clothes—

held by the end in her* jaws or mandibles which she carries before her, and which forms a load almost as large as her own body, or even larger if it be the cocoon of a future male or female. But the cocoons have perhaps not long been placed in the warmer cells, or laid in some passage or gallery near the opening of a shaft, when the sun becomes obscured and a shower Now although the white covering of begins to fall. the cocoons is a tolerably tough and strong material, yet it would not do for them to be exposed to both cold and damp, and the careful nurses have to set to work to carry their charges all back to the lowermost cells where the rain will not reach them—to bring them up again, it may be, before the day is over, in case the sun should re-appear. No end is there in fact to the tender care, and indefatigable attention of the nurses. It has been no doubt this running about with the white cocoons in their mandibles, or the finding of them in their nests in the winter, which has led to the mistake of supposing that ants stored up grains of corn and other seeds, which is certainly not the case with any ants known in England, who pass the winter in a dormant state. Naturalists have however lately become aware that a peculiar species of ant found in some other countries, does lay up a store of food such as corn and rice, and have named them 'harvesting ants.' It may have been of such, that King Solomon speaks, who was so knowing about plants and

^{*}We may say her, since it has been discovered that the working ants are really females, though imperfectly formed ones, so that they do not produce eggs.

animals, where in his proverbs he describes the ant-as "providing her meat in summer and getting her food in the harvest," while in another way his knowledge was also most correct, since he speaks of the ant as "having no guide, overseer, or ruler," for it is certain that all the operations of the working ant, all her busy industry and anxiety for the good of the community to which she belongs, arises from an impulse within the little creature forming part of her nature, which is very like the love of duty in a human being. It does not surprise us to find other animals taking tender care of their young, and we admire the devotion and self-denial which they often show towards them, but with the ant-nurses it is the young of others whom they tend, and the good of the whole of their fellow-citizens, which is the aim of their labour. They seem to have the feeling which we call love of our country, or national honour and pride. They are not slaves by any means, for no one orders or exercises authority over them—they are rather willing and devoted servants to the general good. The powers. feelings, and affections of ants being so many and so curious, it has been said that the brain of an ant, perhaps no larger than a fine grain of sand, must be the most wonderful particle of matter in the world.

But though our ants do not store up food, nor eat in the winter, it has at other times a good appetite, and within our garden walls an abundant supply of food is found, suited to the taste and fitted for the nourishment of the ant colonies. They like most kinds of fruits, sweet roots,

and even the flesh of slugs and snails. A dead mouse or sparrow is soon attacked and their bones picked clean by hungry ants. We know too well how a fallen pear or apple is often found to be hollowed out by ants, and how our peaches and nectarines are attacked by them and riddled with holes. Nothing in fact that is sweet comes amiss to them, and portions of food are at all times carried down by the workers to the grubs or larvæ hatched from the eggs, or to the young ants which have just left the cocoons. Their strong jaws or mandibles enable them to bite solid food and carry it in their mouths, while they have also a kind of hollow tongue like a scoop which can be used for lapping up liquids. and is perhaps employed for taking home some of We know how wonderful the sweet juices of fruit. is sometimes the persistent industry and determination of the little creatures, in getting at the kinds of food they like best. To an ant-city at one side of our garden, for instance, there is carried somehow in August the perfume of the ripening peaches on the wall at the opposite side. We cannot detect the fragrant odour so far off ourselves, but the sensitive nerves of the tiny ants must discover it in the air. It may, to be sure, be possible that some adventurous ant traveller has penetrated across the vast (to them) extent of land which stretches between their hive and the wall where hang the downy peaches that are getting softer and sweeter every day, and that he has journeyed back to tell his fellow citizens what he has discovered, and has induced a large party to set off and

make a causeway across the paths and beds, and form tunnels under the turf borders, to where the peaches can be reached by climbing the wall. We can easily see that a long procession of them is constantly doing this, though we know not exactly how they have first been induced to undertake such a distant exploration. But there can be no doubt that ants have wonderful ways of communicating with each other, nor that they have something like a language of their own. If we watch a party going to and fro across a path, we soon observe that they occasionally stop as they pass each other, touch one another with their feelers or antennæ, and then continue their route, much as we do ourselves when we meet a friend and have a chat with him in the street. Naturalists who have observed the ways of ants very carefully and constantly, have seen that when any calamity has occurred in the colony, the workers will run about and tell the news to those at a distance, with a touch of their feelers, and that then all who are so warned will hurry to the scene of the disaster in order to set about repairing it. Perhaps even sounds are emitted by ants, and many other insects, which are too fine and high pitched for our ears to hear, as the elephant who hears the deep notes of an organ or drum, cannot hear the high and shrill notes of a pipe or flute. There have been cases where ants seem to have got scent of some store of honey, or treacle, or sweet preserve within a house, and have journeyed a long distance in great numbers to reach it, even making their way down chimneys

to get to the luscious store, but our garden ants are generally contented with what they can find without doors.

Nothing, too, is more certainly true in the ways of ants, than that they supply their keen craving for sweet liquid food by having recourse to the honey dew which is secreted from the bodies of the little green aphis



APHIS—"THE COW OF THE ANT" highly magnified.

or plant louse, which lives upon the sap of our rose trees, and of which other kinds are to be found on our larger trees, such as the poplar, oak, lime, and apple tree. The rose aphides have even been called the 'cattle of the ants,' and the latter are said to milk them like cows for their sweet juices, and even to capture them and keep them in their hives for this purpose. Watching the stem of a rose which happens to be covered with these delicate little creatures in thick clusters, we shall not be long before we perceive some ants among them, and with a magnifying glass may detect one touching an aphis with its feelers, striking with a rapid motion like

the beating of two drum-sticks just where two little projections stand out from the back of the aphis like a double tail. These are the teats of the ant's cow, and soon there can be seen oozing out from them drops of the sweet syrup which the ant eagerly laps up. The life of the aphis is one long process of sucking up the sap of the rose stem, first piercing it with the sharp proboscis beneath its head, which penetrates the outer green bark and acts also as a sucker. The sap of the plant, which at first is not sweet, as it circulates in the rose stem, becomes converted into a kind of honey in the body of the aphis. as the nectar of flowers is changed into honey in the body of the bee. And there can be no doubt that as the bee carries home within its body to the hive the juices of flowers, so the ant carries to the male and female ants, or young ones at home, some of the sweet honey dew it has lapped up. So fond are ants of this kind of food that they will even excavate long underground passages like railway tunnels, to the foot of the trees or shrubs where are to be found the different species of aphis or plant lice, in order that they may make their way easily backward and forward from the hive during the season when the honey dew is being produced by the aphides.

And now we must return to the history of the cocoons, which the nursing ants take so much care of, and carry up and down according as they want extra warmth for them to bring them to maturity—the shifting and carrying about of the little white oblong cocoons in their

jaws going on for some weeks of spring, and then, from some tokens best known to the watchful nurses, they find that the young ant has come to perfection within the cocoon, and is ready to come out and enter upon ant life and be fed; and not waiting until the little insect has made its own way out of its envelope, as the young bird contrives to do from its enveloping shell, the workers have been seen to bite the ends of the cocoons, and making an aperture, help the young ants to extricate themselves from them. Sometimes this matter is not so easily managed, and two workers have been seen pulling at the little creature to disentangle it from the cocoon. The ant once launched into life, it makes all the difference in its value and importance to its native city. whether it has proved to be a male or female, or merely an ordinary worker like those who assisted at its birth, and since the two former are much larger than the workers, it follows that the cocoons are also larger, and have been from the first placed in larger cells prepared especially for them, so that even from the time of the egg being laid by the mother ant it has been the most carefully preserved and tended. The females are much the largest of the three kinds of ants, and are at all times treated with the greatest honour and respect, and get the choicest food and the most abundant supply of it, since they are to become the mothers of the future generation which is to keep up the numbers of the ant colony. Ants do not, like bees, make a queen of one particular mother ant, but are glad to have among them as many

mothers as possible. When they emerge from the cocoons, both males and females are furnished with gauzy
wings, destined to be used when the time comes for their
leaving the hive and pairing, until which time they remain in their cells, waited on by their attendant nurses.
Perhaps it would not be very incorrect to say that these
latter again change their characters at this period, and
take upon themselves the office of jailers, while they
watch most carefully to prevent the escape of the females
from the hive. What can those silvery wings be for if
not for flying with, in the air and sunshine above ground,
and when once the mother ants are gone, who can tell
if ever they will return again?

At length the time comes when all the watchfulness of the workers and all attempts to retain the The summer is suffifemale ants become useless. ciently advanced, and the wings must be expanded and used for the purpose for which they were intended, and on some particularly warm day, the males first making their way out of the hive, they are followed by the females in spite of all the opposition of their guardians, and take flight into the soft air and bright sunshine. In terrible concern and dismay, the workers swarm up to the surface of the ground. The constant objects of their care, whether as nurses or jailers, are gone, and need them no longer. Thousands of antlengths high up above them, they are sporting in the air, among all the other winged creatures—birds, butterflies, bees, wasps, and gnats. What a change from the cold,

dark, underground cells, in the old ant city! The male ants never return to it again, and we know not what becomes of them. They fall a prey perhaps to flycatching birds, or perish with the cold of evening and its damp dews, or are captured in spiders' webs. females, however, seem to have an instinct which brings them back to the neighbourhood of their native home. around which workers place themselves as scouts, at considerable distances, on the look-out for them. sooner is a female ant descried than she is surrounded by a number of her old jailers, and led back to the underground city again in triumph, in order that in one of the cells prepared for her she may in due time deposit her eggs. A few female ants so captured are sufficient to secure the continuance of a numerous population. and they again become the objects of most obsequious devotion on the part of the workers until this is accomplished. A group of attendants constantly surrounds them, and their presence seems always a cause of joy and exultation. The workers have a way of skipping and leaping around them, and perform many kinds of frolics, to congratulate each other when a female is captured. "Some of them gently walk over her," says an observer of ants; "others dance over her, to show their loyalty and affection." No sooner, however, has a female ant laid any eggs in a cell than the attendants immediately make these the objects of their care and attention, instead of herself, and the ant mother will wander away and deposit eggs in another

cell. Should she die before she has laid any eggs, the attendants will stay with the body for several days, brushing and licking her in token of affection, or in hopes of restoring her to life.

Before the mother ants begin to lay their eggs, however, a most singular operation has to be gone through, which is unlike anything done by any other creature. Their silvery wings, which enabled them to enjoy such a pleasant time in the open air, being no longer wanted for flying abroad, are to be cast aside as useless appendages, and the female, by biting the joints where they are attached to her body, and by bending them backwards and forwards over her back and head, gradually works them off. Henceforth she has only the task to perform of laying her eggs; the eggs in due time are hatched, and the young grubs or larvæ, after being carefully fed by the workers, whom we may again call nurses, weave a covering around themselves, pass through the change undergone by all insects within their white cocoons, until they become perfect ants.

There are several very distinct species of ants to be met with in our woods and fields, somewhat different in their habits to those we have described, some of whom raise high hillocks of earth above the surface of the ground, in which they have different storeys of cells and galleries, used in warm weather, while other underground apartments are inhabited in winter time. In our gardens we may also distinguish two kinds of ant—the Brown Ant, or 'Formica brunnea,' and the Red Ant, 'Formica

These two species of ant, though they are often near neighbours, would seem to be natural enemies, and each is perceived to guard most jealously their cities or colonies from being invaded by the other. The Red Ant is of a fiercer nature than the Brown Ant, and observers tell of most obstinately fought battles between them and their brown neighbours, in which numbers of the combatants will be slaughtered and left dead upon the battle-In some instances these wars have been supposed to arise from parties of red ants wanting to carry off a supply of female cocoons from the brown ant colony, and in other cases from the brown ants wanting to get the services of some red workers for their own hive; but such supposed origins for the battles seem less likely than that the two races were disputing for possession of some supply of favourite food. We have, however, watched a long-continued single combat between a red and a brown ant, which has been so obstinately carried on and so often renewed that we are ready to believe at all events in their enmity and disposition to fight. Other observers have noticed ants at play, trying to bite each other, and chasing each other like frolicsome children. Very many curious observations have of late years been made on the ways of ants by naturalists, who have constructed glass cases, in which they have managed to establish ant communities, by putting into them ants of the three kinds—workers. males, and females—with a supply of earth for mining and cell-making, and food to their liking. By this means have been observed more plainly their wonderful perseverance and unfailing industry, while it has also been seen that ants are a very cleanly and tidy race, and in all their building and rearing of young take care never to leave any refuse material about, but give themselves the greatest trouble to carry such matter away.

The good qualities in ants have caused them to be held up as an example to human beings in all ages, and we may conclude our history of these little creatures by telling how the perseverance of a single ant served to restore the courage and perseverance of a single man. A story is related of the Tartar prince and hero Timour, or Tamerlane, who at one time being discouraged and cast down by the defeat of his troops in some warlike excursion, was lying in his tent, and happened to notice an ant trying to crawl up its hangings. Striking it down with the end of a straw, the insect again and again renewed its attempts to climb up the curtain, and each time the warrior interrupted its ascent by striking it down. The prince was curious to see how long it would persist in its efforts, and eighty times the little creature renewed its attempts, and was eighty times knocked down, until at length it conquered, the hero himself becoming tired of the contest, while full of admiration for his small conqueror, and he said to himself, "I will imitate this ant, and in like manner I too will conquer;" and renewing his efforts against his own enemies, he became at last the conqueror of all India.

But though men have 'considered the ways' of the ant, in order to be 'wise,' we may well ask our-

selves what the little creatures have ever gained from us, and what sort of a notion they can have of us? We have, of course, many powers and capabilities far above the ants, but it is sad to reflect, that if they are conscious at all of our presence in the world, it can only be as of cruel monsters who often destroy their important works, and who, if they interfere with our comfort or invade our luxuries, will ruthlessly slaughter millions of the innocent inhabitants of their underground cities. Even if we would, we can scarcely become their benefactors or protectors. We can but admire them, learn all that concerns their lives, watch their curious ways, and examine their wonderful workstrying at least to leave these, our little fellow-creatures their place in this great and beautiful world, in which their lives and ours are placed and ordered.



ANTS SWARMING.

CHAPTER V.

THE BUSY ONES, WHO LOOK TO THE FUTURE.



HERE is a retired corner in a certain garden which we know of, where stand the beehives, just where a privet hedge shelters them from the east, and a wall covered with an apricot-tree screens them from the north. On the other side of the wall is the orchard, where in spring, fruit trees are

sure to be blossoming—cherry, plum, pear, and apple in succession; and beyond the hedge lies the kitchen garden, where peas and beans, wall-fruit trees, and currants, and gooseberries, have much to offer to the bees before the summer flowers are fairly ready for them. Behind the hives, the hedge is covered late in spring with the little white spires of privet blossom, and a tangled vine of honeysuckle which climbs among it, puts forth thick clusters of its trumpet-shaped florets; while before the hives are laid out beds of every variety of flowers more or less honey-yielding; to tempt the bees when they do not care to roam farther. Of all the

dwellers in our gardens, bees are the only ones for whom we provide dwellings. How do we explain this kindness to the little creatures? Why do we furnish them with these snug straw dome-shaped hives, and take care that they have about them all the flowers, and blossoms possible which can supply them with food?

We will answer these questions by pretending, after the manner of fables, to have heard a conversation between an old and a young bee, buzzed out one morning early in spring.

Young Bee (taking one of his first flights from the hive, and noticing the outside aspect of the home in which he was born): "Dear me! what a beautiful large house we live in! How grandly formed it is, and how thick its walls are. That is the reason I suppose why we are so snug and warm inside. Did you old bees make it last season?"

Old Bee: "Bless me, no, young one—we only make the combs inside it. These hives are made of twisted stalks of corn which we have nothing to do with, and never can get a drop of honey out of. Men make hives—which are, as you say, very snug and warm, but not after all so difficult to make, or requiring such great precision as our combs inside them."

Young Bee: "Well! now I do think men are kind to us bees. Why, they don't make homes like these hives for the butterflies or beetles, or caterpillars—or even for the wasps, do they?"

Old Bee (buzzing rather sulkily): "No! they do not

—but I can't say I see that that proves any great kindness to us bees. In former days, and even now in other countries, bees get on very well without these great conical straw hives (Old Bee used this word conical because he and his fellow bees are considered very clever mathematicians by nature). They used to make their nests, and form their combs in hollow trees, and holes in rocks and banks; and it did very well—perhaps better on some accounts than these hives, where we are always cramped for room."

Young Bee: "Holes in rocks and hollow trees better than these grand gold coloured domes! Well, I must say I do not agree with you, old worker."

Old Bee: "Don't you, young bee; then all I can say is, wait till the Autumn! Wait till you, and I, and all the rest of us, have toiled, and moiled, and gathered honey from this blossom and that blossom, this flower and that flower, from morn till night, and from day to day the whole summer long. Up, and out, and at work every morning soon after sun-rise, and leaving off only at sundown-backwards and forwards to the hive with our loads, through the long summer day, and only allowing ourselves just a little sip of honey now and then for our own food. Never thinking of anything but how we can get enough to store up for the wants of our people at home, while at other times we are labouring inside the hive at cell-making, to stow it all in for the winter, and to use as cradles for our young ones. And when summer is over—then see what they do with us, and our beautiful

combs all brimful of golden honey! Very kind of them indeed to spare some of our lives (mine, for instance, last autumn), so that we may be able to build more combs and fill them with honey the next summer again. you inexperienced, silly young bee! When you're a little older and wiser, you'll find that the hive-making, and the sparing of our lives too, when the flower season is over, is all in order that they may get every drop of our honey that they want for their uses, uses-abuses, abuses, buz, buz;" and thus ending his discourse, the old bee flies away, anxious after all to get to business again. The young bee, stunned at first with dismay at the terrible revelation made to him by age and experience, settles for a moment in sad contemplation on the tip of a tulip bud, and then catching the scent of some daffodils near at hand, flies off, and is soon buried in the cup of one of them, lapping up the sweet syrup at the bottom with his wonderful tongue, and by the time he meets the old bee again on their return home, with stomachs loaded with honey, he has forgotten all about the knowledge imparted to him in the morning, and both creep in very contentedly at the little entrance to the hive, troubling themselves very little about the selfishness of hive-making and honey-stealing men.

We human beings do keep bees, in order that we may take possession of a good portion of their honey, but we are glad also to have them as dwellers in our gardens, because we like to observe their very curious ways and works. We feel interested in the little creatures, because although they differ so greatly from us in size and form, they are like us in some of their qualities, and in many of their doings. Bees have skill and industry, and forethought like men. They are clever in providing for their present wants, and have a strange knowledge of what awaits them in the future, as if, like men, they learnt it from their parents or from books. They know, for instance, or seem to know, quite as well as men, that flowers do not last all through the year, and out of their mysterious consciousness of this fact, arises all their industry and the exercise of much of their skill. They feel somehow that they have no time to lose—that they must waste no hour of the sunshine which opens the flowers, and they seem aware that in the coming flowerless season they would starve unless they had a store of honey for their use. They act just like men who work for their own support and that of their families, and who save up, and invent and plan in order to provide for the future; and they are even better than men in so doing, because it is for their fellow citizens and neighbours that they exercise their powers—while like men they live together in large communities, working together peacefully, and seem to be obedient to the laws which keep them in order, and enable them to carry out plans successfully. They divide their labours and help one another, some doing one thing, and some another, like the workmen in large factories, all performing a certain amount of work suited to them, which they perform most accurately and perfectly, and yet not so very mechanically,

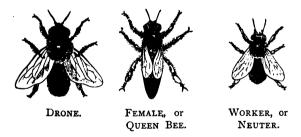
but that on some occasions they appear to *think* about it, and when they meet with obstacles adopt means of overcoming them. For all these reasons, we like to observe and to learn all we can of their curious natures.

Thousands of years ago, in the grand old times of Greece and Rome, when there were great thinkers and poets, and naturalists among the people, there were those who observed and wrote about bees, and considered them most worthy of study. The Greeks called them by a name which meant "flower-loving," and the Romans by one which meant "honey-bearing." In the ancient books of the Jewish people, which form the Old Testament, we know how frequently bees and honey are mentioned, and how their country was described as a land "flowing with milk and honey," which meant that plenty of cattle were upon the hills, and plenty of bees in the valleys; and from our being told in the New Testament, that John the Baptist lived in the desert on "locusts and wild honey," it would seem that in those days people in towns and villages kept bees in their gardens as we do at this time.

The interest and curiosity felt in the ways and doings of bees, have led some persons in modern times, to devote a large portion of their lives to the study and observation of them, and from time to time they have got at the truth about the little creatures, so as to set aside many wrong notions entertained formerly. Glass bee-hives, and wooden hives with glass windows to them covered with shutters, have been invented in order

that they may be watched at their work inside, and especially when in the act of constructing combs, but although these have helped us to learn a good deal about them, it is still difficult to detect all their secrets, and to find out some of their doings from the great crowd of bees engaged upon their work, just when we want most to observe them. In a large and well stocked hive there will sometimes be as many as fifteen thousand bees, so that the separate movements and performances of a single bee at work can scarcely ever be detected, though what is done and produced by the whole community is very well known.

In every nest or hive of what are called "honey or hive bees," to distinguish them from other bees who do not store up honey, and who live solitary lives (like the humble bees which we often see in our gardens), there are three kinds—the males (or drones), the females, and



the workers, and it is these last who are the honey-gatherers, the cell-builders, and those who best deserve

the title of "busy bees." These workers used to be called neuters, and were supposed to be neither males nor females, but are now known to be imperfect females -stunted in their growth, and incapable of laying eggs. They seem, however, quite capable of constant labour for the good of others, and take upon themselves the care of the whole bee family; and it is they who have all the peculiar bee talents and skill. The males do nothing in the way of work, and are treated with little respect, while it only matters to the hive that there should be one female bee, who is to become the mother of a future generation of bees. She is called the Queen, because from the devotion and reverence paid to her it used to be fancied that somehow she governed the rest of the population; but this was a wrong notion, and it is very certain that she issues no commands and exacts no obedience, but is only valued very highly by all the rest, and is taken great care of, because she is to be the sole mother of the future race. As for the males or drones, we need hardly say that they are a very idle set; not even going out to gather honey for themselves, but waiting to be fed at home, and only taking a little flight occasionally from the hive for their health or pleasure, like lazy gentlemen. has been thought by some people that they act as watercarriers to the hive, and by others that they sat on the eggs to hatch them; but all we are sure of is that they mostly stay at home, and may help to keep up the heat of the hive when the workers are away, and that from among them the queen chooses the husband who becomes the father of her future progeny. The drones have broad bodies and blunt tails, while the bodies of the female bees or queens are much longer and more slender, and their wings somewhat shorter than those of the workers. These last are the smallest of the three kinds of bee in a hive, and it is these whom we see gathering honey and pollen from flowers, and who at home produce the wax and build the cells for the reception of the eggs and for the storing of the honey, and who, when the eggs are hatched, take charge of the young larvæ or grubs, and feed and tend them most carefully. In each hive or nest of bees there are usually ten times as many working bees as there are males or drones.

As there are three kinds of bees in a hive, so are there three kinds of material gathered by them to supply the wants of the hive—the nectar of flowers, which becomes honey; the farina, or pollen, of flowers; and another substance which they get from trees, called propolis, or bee-glue. The two first of these substances are found in most flowers, but in some is obtained more nectar, and in others more pollen. If we pull a single flower to pieces, we can mostly detect the little nectary at the base of the style in which the sweet syrup is found which is lapped up by the bee, as well as the little oblong bag at the end of the stamens called the anther, which when a flower is , fully blown splits open and sheds its contents—a white, vellow, red, or brown powder on the style or bunch of styles in the centre. This pollen the bee is as careful to collect as honey. It is not swallowed like the nectar, but

is taken home in little hollow pouches which are in the hind-legs of the workers, and which serve them as baskets, while the hairy ends of their legs help them to brush up and collect the powder. Sometimes when a flower is very full of pollen, like that of the mallow or hollyhock, the little creatures will quite roll themselves in it, and go home to the hive covered with the powder, which they are relieved of by other workers at home, who knead it into bee-bread for the hungry grubs in the cells, of which it forms the sole food. The substance called propolis, or bee-glue, is found on different kinds of trees, such as the poplar, the fir tree, and the horse-chesnut, from which oozes out a sticky kind of resin to protect the young buds. Bees use this as a sort of cement to stop up crevices and cracks of the hive, and to varnish the cell-work of the combs when filled and closed up, and they have it ready also to cover up and embalm as it were any noxious body which may happen to get within the hive. Many other creatures, such as moths, wasps, snails, and ants, attracted perhaps by the smell of honey, will get into a hive, and soon fall victims to their boldness; and after stinging the intruder to death, if they are too large to be removed, the bees will cover them over with propolis, as if to embalm them, and have been known even to take a snail prisoner who was about to enter a hive, by glueing down the edge of the shell to the hive stand, and thus converting his house into his prison.

It may now be asked-where do bees obtain the wax

with which they construct their cells, and which when the combs are emptied of honey, becomes such a useful substance to us for candles and many other purposes? The answer must be, that wax is honey which has been digested in the stomach of the bees, and which is secreted from it in little scales which ooze out from between the overlapping plates which cover the stomach or abdomen outside, like a little coat of mail. When this substance is wanted for cell building, the bees do not get rid of the honey with which their stomachs are filled, but hang themselves up in clusters—the fore-legs of one holding to the hind-legs of another, and so making a number of loops of bees, all hanging together still and quiet, until the contents of their stomachs are quite digested, and the little wax scales are formed. Other workers then come and take these from them, and carry them to the wax-workers and cell-builders, who knead them together for use, just as masons make a mass of mortar before they begin to build walls.

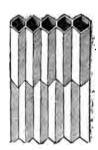
There seems to be always a careful division of labour among the working bees in a hive, so that while one party goes forth to gather materials another party stays at home to build cells or attend to the young. Some observers think that certain workers are always wax-workers, and others always nurse-bees, but it is not certain if this be the case, though it is very certain that while the wax-workers are busy over cell-making, and cannot attend to their own wants, they are most carefully supplied with honey by their fellow-

labourers who have brought home a supply of honey. It is perhaps most natural to fancy that those bees who are engaged in cell-building must have a particular talent for the work which the others do not possess. It is one thing for a bee to be able to discover in each flower-cup or bell, the part which holds the sweet syrup he wants to get at, and to be able to pack up pollen in the little pair of panniers which his thighs are furnished with, and take it all home; and quite another thing to be able to form the little six-sided cells, so wonderfully accurate in size and shape, which are used for storing up the honey, and as cradles for the youngthe walls of each exactly the right shape for taking up the least material and occupying the least space. It is said that someone once asked a clever mathematician to find out what was the best form for taking the least room and using the least material when a number of small chambers had to be built close together, and he calculated and measured, and then decided that there was no form so advantageous as the six-sided, or hexagonal form, which is adopted by bees for their cells all over the world.

The combs formed in a hive are composed of two layers of these six-sided cells, placed end to end, and these ends being each like a little pyramid formed of three sides, they fit in to one another with no space between, and as each bee makes his own cell complete the sides and ends of each cell are double. It has been thought by some naturalists that each bee only tries to make a tube-shaped cell, with round

end like a very long and narrow thimble, and that it is the pressure of all the little workers one against the other, and the soft nature of the wax, which causes the walls and ends of each cell to be angular, since each bee works with six neighbours around him and three at the end. Even if this notion should be the correct explanation, it still leaves the art of bees most wonderful in the exactness with which they work at the same distance apart from each other, and in the many expedients they adopt to suit their work to their purposes.

PORTION OF COMB, shewing how the cells are placed end to end, forming the thickness of the comb.



When bees are employed in building up a comb, they work so fast and in such great numbers that a piece of comb containing four thousand cells has been found to be completed in twenty-four hours by its industrious architects—that number perhaps being employed upon it. The outer ends of all the cells are at first left open. Those which are intended as storehouses for the honey have to be gradually filled

with the little loads brought home in the stomachs or rather honey-bags of the busy workers, after rifling the flowers, and each cell is only covered over and sealed up with wax when filled to the very brim. Cells wanted for the young brood are made rather larger than those for honey, and are left open until the queen or mother-bee has dropped into each of them a single egg, and even then are not closed, because from each egg will be hatched a small white grub, or larva, which has to be carefully fed for a time on the bee-bread, made of pollen meal, which the nurse-bees bring to them and drop into their little wax cradles. When the grub is at last ready to spin itself a cocoon and change into the chrysalis state, the cell is closed up, and it is left to undergo this change in quiet and secresy; and by-and-by the chrysalis, or pupa, is transformed into the perfect insect, and eats its way out of its native cell to enter upon the life of a bee. After this there are to be no more changes, except in the nature of its business, and it has only to shake out its wings, and then sally forth from the hive into the beautiful outer world of sunshine and flowers, with the soft air around, filled with enticing scents from all the nectar cups that it may sip from, just as its fancy pleases. What a change from the dark, hot hive!

And on this coming forth from the hive, how wonderfully is the little creature's body provided with all that is needed for the business and pleasure of its life. First of all, its four gauzy wings, which enable it to mount up into the air, and of which the muscles which give them motion

are so strong that they can fly sometimes as far as two miles and back again without fatigue. The two hindwings are smaller and more delicate than the front pair, and in flight are caught to the latter by means of very small hooks, so that they seem but one pair of wings, and when the bee is at rest are folded beneath the larger and

stronger wings. Then come the six jointed legs, the hind pair being furnished with hollow pouches which serve to carry home to the hive the pollen and little pellets of propolis, or beeglue. These small receptacles are lined with a smooth horny substance, to which the pollen does not adhere, and around their edges stands out a fringe of strong bristles, which prevent the contents carried from falling out, while the hairs on all the legs, and especially those on the feet, serve as brushes to sweep up the pollen.



HIND-LEG OF BEE, showing the pollen pouch.

The proboscis of a bee is a most curious little tool, or rather a collection of little tools, all of which have no doubt their meaning and purpose, and are used in all the different works which the busy creature spends its life in performing. The microscope shows us that it can be opened out into five different parts, the centre one of which is a long flexible tongue, which can be bent in every direction as it licks or laps up the nectar in the flowers, for a bee neither sucks up its food with a spongy

proboscis like a fly, nor with a long tube like a butterfly. At the bottom of the tongue we see the oblong bag into which the sweet juice is gathered, and where it undergoes the change which turns it into honey. On



PROBOSCIS OF BEE.

each side of the tongue are two jointed parts something like fingers, which are supposed to be used in gathering up the pollen, and perhaps also in kneading it into bee-bread, and it may be also in moulding the wax in cellmaking. These parts, or organs, as well as the tongue, can be shut up in the two outer sheaths, which are smooth and horny, and furnished with

bristles, so that the proboscis then forms one sharp-pointed tool, which is probably used in cutting and modelling wax, but as we can neither take our microscopes into the heart of a flower nor get into a hive with them, people who have even spent their lives in observing the ways of bees are obliged to guess how the little case of instruments is turned to account. But we can judge how admirably each one must serve its purpose by the accuracy and perfection of the works performed with it.

Perhaps the eyes of bees are still more wonderful instruments, and they have what may be called two different sets of them. First, two large eyes on each side of the head, composed of a multitude of separate little eyelets, each with a single hair standing out from its

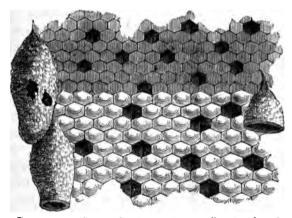
border, so that the whole eye is thus covered with a hairy covering which must protect it from the fine pollen dust when busy in the heart of a flower. Besides these two compound eyes, it has three other eyes in the front of its head, the use of which is not very certain, but since a bee has to work in the dark hive as well as in the bright sunshine, it may be that these are used when at home. Bees must also have a very acute sense of smell, guiding them even to great distances in search of flowers which send forth scent, and it is thought by some that their antennæ or feelers are the organs of smell, while it would seem as if they also were used in communicating with each other, and that their delicate touch helps the wax worker in his cell-building.

The sting of a bee is composed of a sharp stiletto, which first pierces and then pours poison into the wound it makes, and is such a formidable weapon of defence that we are careful to leave them undisturbed at their labours. When a bee is dissected, it is found to have The first is used as a two quite separate stomachs. honey-bag, in which the nectar of flowers is collected. and where it undergoes the change which makes it honey when it is disgorged on returning to the hive. second stomach is that in which the honey is changed still more and becomes wax. It is like a cask with hoops on the inside, and has openings through which the wax oozes, in the form of tiny scales, which lie under the overlapping plates that cover the stomach outside like These little cases in which the wax is found are sometimes called wax pockets.

When bees are making their combs they begin at the top and work downwards, and the different combs in a hive are built side by side, about half-an-inch apart, so that the workers can easily get at each side of them, and pass each other when at work in crowds. The combs are about two inches in thickness, just what the length of two cells placed end to end makes them. The French call them "gateaux de miel," or "cakes of honey," and such as come out of our round hives are not unlike thick cakes rounded at the edge; but when bees have their nests in the hollow trunks of large trees, they will sometimes go on increasing the size of a comb until it is a yard or more in length. In those combs which are intended for the broods, there are a few cells in each hive made much larger than the rest, and of an oblong shape. with the hollow within something like the inside of a small thimble; and these are prepared for the female bees, one of which is intended to be a future queensuch cells, so different from the ordinary six-sided cells, being placed quite apart at the edge of the comb.* When an egg is hatched which has been laid in one of these royal

^{*} The cell intended for a royal cell is formed like an inverted acorn cup (as on right side of the annexed cut), when the queen bee deposits a single egg in it, which adheres to the end. The workers then enlarge the cell by adding more and more wax to it, until it becomes the size and shape of the cells represented on the left side of cut. When the grub is hatched from the egg it lies along the cell head downwards, ready to be fed, and only when about to change to a chrysalis is the cell closed at the bottom. In the upper cell is shown where the perfect queen bee has made her escape.

cells, the little grub has the greatest care and attention bestowed upon it. It is fed with a sort of rich pap made of pollen and honey, and has a greater amount of food given to it than the rest, so that it becomes in time the large and slender-shaped bee which is fitted to become the queen-mother to a future race of bees.



PORTION OF COMB, shewing ordinary cells, closed and open, and Royal or Queen's cells.

When it happens that a young queen has come to perfection, the old queen would seem to consider it time to establish a new community; and suddenly, some warm day in autumn, she leaves the nest, and, surrounded by crowds of drones and workers, rises up into the air, and after whirling about for some time, they all settle at last on some bough of a tree not far off

from the old hive, and seem to deliberate what next to do. We scarcely know what course would be taken by the party of emigrants, if left to themselves; for directly it is found that the bees of a hive are leaving it—or beginning to "swarm," as it is called—a new hive is brought out, and the cluster of bees is swept into it, taking care that the queen does not escape, and before many hours are over the new community is found to be building up wax combs within, and going abroad to collect honey, and pollen, and bee-glue, and living the usual life of bees, and working at their usual works.

Besides the hive or honey bees, we perhaps see many other species of bees in our gardens in the course of a summer, since there are as many as two hundred and fifty different kinds found in England; many of these are what are called solitary bees, and instead of living in communities like our hive bees, make themselves little caves or burrows in banks and underground, and collect only honey and pollen sufficient for their own food and that of their young. Some of them, after forming balls of a kind of paste made of honey and pollen, lay two or three eggs in it, so that when the grubs are hatched the next spring, long after the cold of winter has killed the parent bees, they have a supply of food around them upon which they feed until the time comes for changing into the chrysalis form, after which they become perfect bees. Another kind of solitary bee makes most curious nests or cells for its eggs, formed of oval pieces of roseleaf which it cuts out with its proboscis with great precision and carries to its subterranean home, and then sticks together, one little portion of leaf being bent round and laid upon another until a little thimble-shaped cell is formed.



LEAF-CUTTING BEE.

The bee we most often notice in our gardens, is, perhaps, the large handsome bee with the black and yellow velvet-like coat which we call the humble bee. On hot summer days we are sure to hear his loud sleepy

hum as he hovers among our flowers, and can observe him tumbling as it were, into widely opened flowers, and such as have tubes and cups large enough to admit him, and we see how sure he is to come out of them covered with white, red, or yellow pollen according to their kind which has clung to his back and legs. The humble bees live in small communities of at most two or three hundred, using as a nest some hollow in a bank or a burrow underground which has been made by some other



GARDEN HUMBLE BEE (BOMBUS HORTORUM).

creature. They only gather honey enough to serve for their food and for wax secreting, and for mixing with pollen to make pap or bee-bread for the grubs. Many females live in their communities, so that they have not a queen bee to whom they pay such attention and deference as in hives. Their ways are also much less regular and methodical than hive bees, for they build no combs and their cells are neither packed closely together nor are they six-sided, but are round and oblong like little jars or pots, while cocoons and balls of bee-bread in which are the eggs, and jars of honey and pollen are found in their nests all piled together in seeming disorder.

But though the humble bee stores up no honey which we human beings can appropriate, and do not appear to be as clever or careful as hive bees, yet it has been discovered by naturalists that this species of bee performs unconsciously a very important office in carrying on their silken coats the fertilizing pollen which some flowers require to have brought to them before they can bear seed or fruit; and they have also remarked that such bees are in the habit of going to flowers of one kind only during each excursion from home, by which means the pollen of one flower is not carried to that of another kind.

And now we must return again to our account of the honey or hive bee, not attempting, however, to tell all the particulars of their doings within the hive, which those who have observed and watched them very closely, have from time to time discovered. It is less difficult to find out some of their ways when abroad collecting honey and pollen and propolis. We find that they stay away from the hive about half an hour when in search of honey, and a little less than this time when collecting pollen, while they will occasionally make still longer journeys if such an inducement comes as a field of clover or of beans in blossom, which attracts them from afar by their sweet perfume; and they will also make longer flights to get at a stream of water, of which they are very fond, and perhaps use within the hive in kneading pollen and As we watch them among the flowers of our gardens, they seem very fanciful and capricious, as they flit about taking honey from one flower on a plant and leaving others untouched, collecting pollen from one flower-bell, and leaving others equally full of it for their fellow-labourers. Some flowers have evidently tubes too long for them to send their tongues down to the bottom. and some are too narrow for the entrance of their bodies; these they are obliged to leave for the long proboscis of some butterfly or moth. Sometimes, as with the short narrow-tubed flowers of the jasmine, whose scent has attracted them, they contrive to get at the sweet juice by piercing a hole at the bottom of the tube. In the flowers of the snapdragon, though the lips of the corolla seem so firmly closed, bees will force themselves in, and get out of the little flower-trap again, which opens with a spring, and snaps to again after they have made their escape; and here the bee has it all to himself, as no moth or butterfly could perform the same exploits. In the flower of the honeysuckle, with its narrow tubes, we have wondered how the plant came to be so frequented by bees, and have found that the abundant nectar of each little floret runs down the style in the centre and hangs about the small knob or stigma at the end, so that it is easily licked off by the bee.

The honey, or, rather, nectar of flowers (for it is not properly called honey until it has undergone a change in the stomach of the bee) is yielded in different quantities and is different in quality according to the season and the time of day. No time is so favourable for honey gathering as the early morning, when flowers are first opening out to the sun, and before the

nectar has been evaporated by its warmth. A story is told of some peasants of Bavaria, in a district of that country where hives were so generally kept and made a profit of, that a sort of rivalry was kept up as to the quantity of honey each bee-master could obtain from his hives. It was found year after year that one old man was constantly able to get more honey than any of his neighbours, although his bees had just the same flowery fields and hills to wander over as their own. What could be the cause of his success? Puzzled and jealous, the others at last accused him of witchcraft, and the old beemaster had to explain that the simple cause of the mystery was that he had taken care to place his hives in a southeasternly direction, so that his bees being awakened up by the warm rays of the sun as it rose, and sallying forth the earliest, got the freshest and sweetest and most abundant harvest of honey.

Beekeepers in many countries are in the habit of moving their hives to fresh districts when the honey about them has been exhausted, or the season for some honey-bearing flowers is to be found elsewhere. A peasant will take his hive on his back to some heather-covered hill many miles off; and in Switzerland the inhabitants of the valleys will send their hives up to the care of the herdsmen who are watching their flocks on the mountain side. In Egypt, where along the valley of the Nile the season for particular flowers varies according as the districts where they grow are further to the south, the peasants will send their

hives up the river, each numbered so as to be claimed again; and then a boat freighted with numbers of them will be allowed to float slowly down the stream, while the bees go forth to gather rich harvests on the banks, getting the perfumed honey from the orange blossoms of one district, from the sweet jasmine of another, and the roses of others, as they come into bloom.

Other creatures besides men are fond of honey, especially bears, and in America the bee-hunters will make use of these animals to track the bees to the hollow trees in which are their nests. The bear's sense of smell is quick in detecting where honey is stored within, and after rubbing their noses against the bark will begin to gnaw a hole in the trunk. Some other creatures will capture bees themselves for the sake of the honey in their stomachs. A toad, it is said, will sit under a stand of hives, ready to pounce on any stray bee which may alight near him, and tom-tits in some parts of England are called bee-biters. from their practice of tapping at the walls of hives with their beaks, which bringing out bees as if to inquire "Who is there?" they are snapped up. To prevent the entrance of a particular kind of moth very fond of honey, bees are said sometimes to make winding passages at the entrance of their hives of wax and propolis, only just wide enough to admit their own bodies.

The stings of bees—their very formidable weapons of defence—make it not an easy matter to rob their hives each autumn of a portion of the honey made in the summer, each hive being like a little fortress

full of thousands of well-armed soldiers, ready to resist any attempt to carry off the contents of the treasure chambers within it. In former days, it used to be the common custom to destroy the whole of the bees in a hive, and to capture all the combs, but a more humane method is now adopted of merely stupifying the bees for a time, and then leaving within the hive sufficient honeycomb to supply their wants during the winter. We do not scruple to help ourselves to some of their honey, and consider that we have as good a claim to it, as to the milk of the cow, or the wool and flesh of the sheep. Before men discovered how to make sugar from the juice of a tropical cane, the honey of bees supplied to them a want—for by nature we are made to desire sweet food; but now honey may be looked upon only as a luxury for which we are indebted to these little creatures, and the increase in our knowledge of their ways and works makes us more reluctant to destroy their lives unnecessarily. The natural life of a bee, too, is not a long one, and though a queen bee will sometimes be found to have lived as long as three years, becoming during that time the mother of perhaps a million of offspring, yet the laborious and clever working bee seldom lives longer than a year and a half at the most, while the male bees either die a natural death in the autumn or are not allowed to live through the winter to consume the stores to which they have never added, and are deliberately put to death by the stings of the workers.

And during that short life of the working bee, how curiously varied are her labours and doings! First a small grey grub, eating voraciously the loaves of beebread popped into her little cradle-cell by careful nurses. Then after growing very fast, beginning on a sudden to spin and weave, wrapping herself up in a close



fitting garment of silk as if even the privacy of the waxen cells were not enough to conceal her while undergoing the mysterious transformation, during which the almost shapeless body is supplied with wings, legs, feelers, proboscis, tongue, and sting; a honey-making stomach, and another for secreting wax. And when as a perfect bee, she has come forth and become, first a diligent searcher after flower-nectar, and flower-meal, and treeresins—after bread-making and wax-secreting, and wax-kneading, she exercises at last the highest of her powers and becomes a skilful architect, executing on what are

like very scientific principles, and with the greatest accuracy and precision those works which may be said to have been the wonder of the whole world in all ages.

And then when all is over and the short life of the busy worker-bee is ended, we may be sure that the little creature has had a pleasurable existence, and that the exercise of all her industry and skill has brought her a species of satisfaction—that her labours have been labours of love, and after all to her, Work has been only that which we call Happiness.



CHAPTER VI.

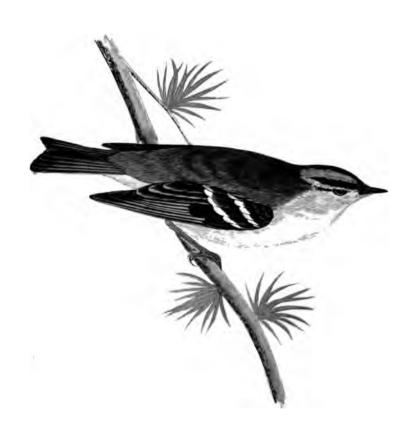
OUR GARDEN CHORISTERS.



MONG the boughs and branches of our garden trees, which serve them for singing galleries, our choristers begin their performances very early in each year; even before the buds have opened out

and spread over them their canopies of green leaves, we find out some sunny morning, by the singing of birds, that spring must certainly have come. even seem to recognise the very same set of choristers chirping their "matins," and singing their madrigals, as performed on the very same boughs the year before; and if some new members have been added to the choir in the place of old favourites, we may be pretty sure that they are the offspring of choristers we have formerly heard, and have learned their different notes from their parents. The same warbling and whistling, interspersed with little chirps and twitters—the same trills, and quavers, and gurglings, and pipings of each, according to its kind; in fact, we have heard the young birds practising these very notes soon after they were fledged in the former year, and

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GOLD-CRESTED WREN.

know well how, after beginning with faint twitters and small "peep-peeps," they managed at last to bring out the same notes as the parent birds, who had fed and tended them so carefully from the time they had come out of the egg. All the notes, no matter how they differ from each other according to the species of bird, seem to express but one feeling among them. All this gushing out of sweet sounds seems to say, "How happy we are! How pleasant this sunshine is again! How we are all going to enjoy ourselves now winter is gone!" One thing very certain is, that the singing of birds is not to give us pleasure alone, and by-and-by we shall find that it is not even to give vent only to the joy of living, and feeling the pleasant air and the warm sunshine, nor because they are satisfied to find that the soil is again soft and damp, so that worms and slugs may be expected, and that the buds begin to swell, promising future caterpillars and grubs, but because the male birds, who are the principal singers, have each a mate to choose for the coming season, and must make himself agreeable, and win the affections of that particular hen-bird of its kind with whom he has chanced to form an acquaintance.

As that wren pours forth its delicate trilling, as if it would crack its little throat, we may find on a bough very near at hand a young "Jenny" wren sitting, listening attentively with her head a little on one side. She thinks it no doubt a most charming song, and knows quite well that it is intended for her. She feels herself chosen as the mate of the singer, and is satisfied that her career in

that year's life should be settled. And so with the young thrush who sits perched on a laburnum tree near our window, pouring forth all the lovely notes he learned from his parent the last summer. He means to have a mate and a nest of his own this season, and sings his very best to attract and please the young hen-thrush who is listening to his song on the neighbouring acacia tree. And thus with them all. They choose their mates all on a sudden, and never change their minds about the matter; and the female birds are generally very easy to be convinced that the male bird who has come after her and sang to her, and plumed his feathers before her, and shown off his little airs and graces in her sight, is the best and prettiest and most loveable wren, linnet, chaffinch, or thrush, as the case may be, in the whole garden; and henceforth they are a pair, and there becomes but one mind and purpose between them.

Perhaps our more usual feeling with regard to birds, as we merely hear them, is that they are as careless and idle as they are happy; but this is to have a very wrong notion about them; and at all times amid the pouring out of their gladness in song, they are thinking of business, and during the greater part of the pleasant days of spring and early summer, the birds of our garden are as busy as their neighbours, the bees. Singing is all very well at the proper time, but when their mates are once chosen they have a great deal of important business before them, and no time to lose. They have to set about building a nest, ready for the eggs which the hen

will soon lay—a snug little nest, somewhere out of sight, just the right size and form for the number of eggs which will lie at the bottom, and for the mother-bird to sit comfortably upon them, so as to give them the warmth from her body that they will need for coming to perfection—and by coming to perfection we mean coming to be birds, instead of eggs.

Let us only watch, as spring advances, the doings of birds, and we shall see many tokens of this nest-building going on. We shall observe birds with twigs and the fibres of plant-roots in their beaks, flitting hastily by. Others with long straws streaming after them, of which they have tight hold at one end. Others with tufts of hav and bits of rag. Others with little flakes of wool, which they have found on the brambles of a neighbouring common, left by the sheep the year before. Others with long hairs from the tails of horses and cows, and others with bits of cobweb-in fact, all sorts of materials are turned to account in the nests built by different species of birds. The whole time and thought, as it were, of the busy creatures are engrossed in their task, and every flight is engaged in the search for something which can be made use of in nest-building; and if they cannot find at hand what they want, they will go to considerable distances sometimes in search of them, or in some cases use substitutes when the nest is wanted in a hurry; though each nest is sure under any circumstances to have something betokening the kind of bird who was its architect. A soft pad of wool or hay, old feathers or tufts of down

felted together, forms often the foundation of the nests of small birds, and then the root fibres, twigs, straw, and hav are woven round and round, and twisted in and out. and bent and tucked in and plaited together, till all is snug and warm and compact, just of the form and size to best suit the body of the mother-bird. Some of our small birds use a great deal of moss in the construction of their nests, such as the chaffinch, who also adorns his with little scraps of grey and yellow lichen from the bark of the very old apple tree in which he builds it, so that it is scarcely distinguishable from the branches. Nothing indeed can be more carefully and artfully chosen than the nooks in which most of them are placed, whether they be hid among the ivy on a wall or in the centre of a bushy evergreen, or placed so high up among the branches of a tree as to be beyond reach, and concealed from sight from below by the foliage. Shelter from wind and rain seems one object, and the other concealment from prying eyes. Even when we can see that a nest has been built in the centre of a hedge, we should almost be obliged to pull the hedge to pieces to get at it, yet the proprietors have a secret passage of their own among the twigs, and find their way in and out to it, with the greatest ease. With the swallows, who build under the eaves of our house, there is but one kind of material needed, since their nests are built up with little beak-fulls of wet clay, the birds travelling backwards and forwards with unwearying industry and perseverance to the banks of a pond a long flight off to get it.

Nest-building is a sort of joint concern between the pair who are going to set up house-keeping-or, rather, who aim at securing the safety and comfort of their future family, since the nest is rather a family cradle than a dwelling. They choose together the situation where it shall be placed, and as the male bird goes on an exploring expedition, the female may be seen flying after him from bush to bush and tree to tree, the male uttering little chirps by way of signals to induce her to follow him. When the best possible situation is found the building commences, the female bird in most instances staying at home to weave the materials together, and the male going forth to collect them. Nothing can be more wonderful, when we come to think of it, than the fact that when young and inexperienced birds of any species begin to build a nest for their future family, they set about it in exactly the same way as their parents did before they came into life—each bird of each kind from generation to generation making its nest in exactly the same way as its ancestor-birds have done. It may seem possible that they have some kind of remembrance of the snug little home in which each of them first saw light—where they first pecked themselves out of the egg, and where they had such delicious caterpillars, grubs, and flies brought to them by their parents, but they can have no remembrance of nest-building, and of how to first set about it, and what materials to use, and where to build. Each bird builds its nest from the same kind of instinct, the same skill that needs no teaching, as

all animals are supplied with, for adapting their lives to their nature and wants, while human beings have to *learn* the arts they practise. A poet has so well described this natural cleverness on the part of birds, that the lines deserve to be given in every book which tells of nest-building:—

"Mark it well, within, without;
No tool had he to fix, no glue to join,
No bodkin to insert; his little beak was all;
And yet how neatly finished!
What nice hand, with all the means and implements of art,
And twenty years' apprenticeship to boot,
Could fashion such another?"



NEST OF MISSEL THRUSH.

By the time the nest is completed, the hen is quite ready to lay her eggs in it—three, four, five, six, seven, or even with some birds as many as ten or fifteen—whitish, blueish, greenish, speckled, or spotted, as the case may be, and all are laid pretty nearly at the same time, since all are hatched nearly together; and once





OUR GARDEN CHORISTERS.

having settled herself upon them, pressing her soft warm breast above them, she never leaves the nest. All the food she gets is brought to her by her attentive mate. What he likes best himself he brings to her, whether it be last year's seeds or berries, or fresh young worms and slugs, or caterpillars picked off leaves, or flies caught on the wing. And when after sitting day after day for perhaps a couple of weeks, she at last feels or hears the first attempts made by a young bird to escape from its egg, she helps him to free himself from the shell, and then one after another making these attempts, and extricating themselves from the eggs, the remains of egg-shell are thrown out of the nest, and the young family of soft yellow or pale brown little fledglings are ready to be fed. They soon make their wants known by the open beaks which gape for food, and by the small piping cry from their little throats which asks for it as plainly as birds can speak.

Then comes more business for the tender and faithful parents, both male and female, whose whole concern is now to provide for the helpless little ones. Backwards and forwards they may be seen flying with the provender which will best suit the tastes and serve as nourishment for them. Even the sparrows, which we are accustomed to look upon as the most frivolous and aimless of birds, are most careful and indefatigable providers of food for their young, and have been found to feed them as often as thirty-six times in the course of an hour. Chaffinches and goldfinches are equally per-

severing in flying to and fro in their search for the dainty caterpillars and worms, which they bring to their young in their snug little oblong nests in the forks of our



apple-trees. The thrushes begin in the very earliest dawn—when we should perhaps still call it night—to seek food for their young, and go on feeding them until the sun is high in the heavens, and have been found by those who have carefully counted their journeys backwards and forwards to have fed their young as often as two hundred and sixteen times in seven hours. The blackbird does not get up quite so early in the morning, and yet with its mate will collect an immense number of worms and slugs for their young; and among the birds that frequent our gardens none are more tender and devoted parents in the care of their young fledglings (which are scarcely larger than humming birds), than the race of titmice, who are found to take small grubs and flies to

their nests as often as four hundred and seventy-five times in the course of a day. Such birds as those who require food for their young which can be obtained in great abundance, are often able to hatch and rear two or three broods in the year, so that their time is fully employed during the whole spring and summer with their family duties.

And all such birds have most cunning ways of getting at food for themselves and their young, which their sight is most acute in detecting. Their eyes have, in fact, the power both of telescopes and microscopes, for they see at great distances, and can perceive very small objects. From on high, when flying, they will see the worm which has ventured to come above ground, and they can also detect upon buds and leaves the very



small eggs of insects, and minute flies and beetles, which we could only see with a magnifying glass. The same bird that can distinguish such small objects near to it, can see distant objects twenty times further off than men and dogs can perceive them. Even in the most rapid flights, birds will detect beneath them the objects they are in search of for food, and dart upon them with such certainty and precision that they never fail to capture them.

Although birds are so different in their outward forms to quadrupeds, fishes, and reptiles, yet when all the animals on the face of the earth are divided into a few large divisions (sorted, as it were, into a few sorts), according to their internal structure, birds are found to be like them in what causes them all to be called vertebrated animals, which means that they have all spines or back-bones, made up of a number of other small bones fitting into each other very closely, and making one long, strong, and more or less flexible bone, with which all the other bones of their bodies are connected. The rest of the structure of such animals is more complicated and perfect, and makes their life a higher kind of life than that of other animals; and it is because our own bodies are formed in so many respects on the same plan, that we feel as if we were somehow more nearly related to birds than to the other dwellers in our garden which we have already described. We have seen how bees and ants have some powers and clever ways, which have a sort of likeness to the powers and ways of human beings, but we know that the forms of their bodies in no respect resemble ours. It is not however because birds have two eyes, two legs, and that they utter sounds from their throats, that they choose their mates, build nests, and feed their young, that they are like human beings, and that is found this sort of relationship, but because in all the bony structures of their bodies, which otherwise in outward form are so different, there is a great resemblance to that of ours, and because many internal

parts or organs, such as the brain, the heart, the lungs, the liver, etc., are like ours. The circulation of warm red blood through the arteries and veins of birds is also like that of our bodies, as well as the manner in which air is taken in by the lungs and changes the nature of the blood.

But birds differ from us so very greatly in one of their powers that we are sometimes inclined almost to envy them—for what would we not give to be able to fly?—and when we ask ourselves how and why a bird is able to fly, we find that it is in all that gives them the power of flying, that their bodies are quite unlike ours. The forms of their bones, their number and situation, such as their spines, skulls, breast bones, ribs, the bones of their legs, and each of their wings are a good deal like our own, but the structure of the bones themselves is quite different. The bones of human beings and of quadrupeds are mostly solid, or have the hollow space within them filled up with marrow; but the bones of birds are hollow, and have only air within them, and this hollowness, while it makes them much lighter, renders them strong in proportion to the quantity of bony matter of which they are composed. Besides these hollow bones, the whole body of a bird has many cavities and passages, which can be filled as well as their bones with air from their lungs, and we know how all the longest feathers in their wings and tails have hollow parts which we call the quills, just where they are inserted into the body, and into these quill-feathers air from its lungs can

also pass. A bird's body is thus like a small balloon, divided into many compartments, but in order that balloons may be buoyant, or ready to rise and float ' in the air, the air inside them must be lighter than the surrounding air, or they must be filled with some gas which is lighter than common air. Now, as water can become exceedingly light, or—which is the same thing turned into steam by heat, so can air be made much more rare (or thin) and light by being heated. A fireballoon rises because the air inside it is heated, and so made lighter than the surrounding air, and it is found that the air within a bird's body is heated by the quick circulation of its blood, which is kept up by its active habits. A bird is almost always in motion, except when roosting; a large bird taking long flights, and little birds, such as we have in our gardens, constantly taking short flights, hopping about here and there, and flitting from bough to bough and tree to tree. The quantity of food which even such small birds consume is also another means by which the heat of their bodies is kept up. has been found by experiments that they eat as much or more of their kind of food in a day than a man can eat of meat in the same time, and while in flight great quantities of air must be constantly supplied to their lungs. All this exercise and food and air helps to make the blood of the bird circulate very rapidly, and renders the air in its bones and the other air-cells of its body very warm and very light, while its clothing of feathers and down prevents the heat being given out to the surrounding cold air.

We cannot examine closely the mechanism of a bird's wing without finding out how wonderfully it is adapted for its purpose. We see how accurately and smoothly its delicate feathers are lapped one upon another as the wing is closed against the side of the body, and how easily they are spread out, like the unfurling of a fan, so as to beat against the elastic air, which springing back again impels the bird upward and onward in its flight. But for wings to be turned to account, and used so constantly, the muscles and tendons which connect them with the body, and give them motion at the will of the bird, are needed to be much stronger in proportion to its size than those of a man's arm, whose bony structure it greatly resembles. Men have sometimes fancied they might be able to fly by means of wings attached to their arms, but have found that their muscles were not strong enough for the flapping of wings, even if their bodies could be made buoyant enough. The muscles and tendons also in the legs of birds are very strong in proportion to their size, and are needed to help them to first spring into the air before the wings are expanded, so as to present a sufficiently large surface for the air to buoy them up. The whole form of a bird's body is in fact such as to assist them in flight. The sharp beak cutting the air easily, and acting like the prow of a ship. tail serving as a rudder to steer their course, and the wings answering the purpose both of sails and oars. these peculiarities in the bird (and perhaps there are others which we do not understand) give the bird its

power of rising into the air, soaring to great heights, and flying great distances, without any effort or difficulty.



The power of birds to sustain themselves in the air, and perform long journeys without resting, proves the great muscular strength which they possess, and these long flights are very remarkable in those birds which migrate, and which according as seasons change from cold to hot or from hot to cold change their places of abode, and fly north or south to other countries, where the climate is such as will suit their natures. Some birds come to England only during our winter, and cannot bear the warmth of our summers, and others come to us only for the summer, and leave us when our winter approaches. It is these latter who whilst with us lay their eggs and rear their young, so that they seem to belong to us, but they have so strong an instinct, impelling them to avoid our cold winters, that they have no sooner brought up their young than they prepare to leave The cuckoo does not even stay to hatch or rear her

young, but dropping her eggs into the nests of other birds, leaves them to feed her offspring with their owna practice which, however we may admire her curious note, and like to hear it as a token of coming summer. makes us rather despise her. The migratory bird whom we perhaps know most about is the swallow, who does not so much dwell in our garden, as he makes our dwelling his, by building underneath the eaves of our houses his little clay nest. He requires for it just the shelter which our roof or some jutting-out ledge affords him, and there builds it up of clay or mud, fetched bit by bit from the sides of some neighbouring pond, occasionally mixing up with it a little grass or straw, to make the clay hold together, as a mason mixes a little horsehair in his plaster. When the little earthen cradle is formed, the swallow lines it carefully with feathers or down, to make it a comfortable bed for the future young, and then the female swallow lays her eggs in it, an opening having been left at the top large enough to creep in and out. When hatched, there is no bird who tends and feeds its young more assiduously than the swallow, and we see him and his mate the whole day long flying backwards and forwards with food for them, the heads of the little fledglings popping up at the opening of the little clay basket, ready to receive it. When old enough to leave the nest, and yet not equal to long flights, we may notice them sitting in a row on a tree-branch near at hand, waiting to be fed by their parents in turn, and when full-grown and strong on the wing, the parent

birds, having done their duty by them, leave them to cater for themselves, and know them no longer. After perhaps rearing two broods during the summer months, and by the time that autumn has brought cold nights or some early morning frosts, an irresistible impulse fills the whole being of the swallows, urging them to seek a warm climate and a brighter sky, and all their swallow-friends and neighbours have the same impulse within them. They appear to understand each other, and to appoint a place of meeting, and after collecting together in a large flock from every quarter, some fine day about the middle of October, they are seen to whirl round and round for a while high up in the air, as if to make sure of their route, and then start off southwards on their air-voyage, flying over land and sea-our channel-the continent of France—the Mediterranean—to descend at last somewhere we may conclude, among the palm and date trees beneath the sunny sky of Africa, there to enjoy themselves during the frosts and snow of our winter. More than a thousand miles must the swallows fly before arriving at the climate they desire to reach, but they are found to take a rest sometimes on their way, settling for a night on an island of the Mediterranean it may be, or crowding the rigging and decks of a vessel at sea, or even sometimes allowing themselves to drop on to the surface of the sea with their wings expanded, so that they are borne up for a while and gain a short rest from flight. The instinct to fly away to a warmer climate is sometimes so strong in a swallow, that if any

thing has prevented it from completing the rearing of its second brood of young before the time when the migration of its neighbours begins, it will leave them to their fate, and join the party of emigrants who are about to start on their air-voyage to the south.

Just when the swallow leaves us, a beautiful little bird called the siskin comes to England, to spend the winter,

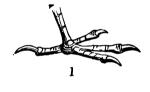


SISKIN.

from the north of Europe. He has been born among the firs and pines of Norway or Sweden, where his food is the seeds of their cones, so that he is mostly to be found during his stay with us in plantations and woods where these trees grow; but he comes also to our gardens when we have larches or other cone-bearing trees. where he is as active and agile as the titmouse in searching out his favourite food among their branches. When spring returns he flies off home again, to make his nest and rear his young in the far north.

Starlings are also another race of birds who make our dwelling theirs for a part of the year, and who then leave us after they have reared their young. Up in one of our unused chimneys, or behind a parapet, or in some roofgutter, they make their spacious nests of sticks and straw and moss, and there rear their family. They are a noisy. bustling, fussy set of birds, making all manner of odd squeaks and pipings, and seeming always to be scrambling and shuffling about, as we overhear their doings from some room beneath the roof. One can scarcely fancy them to be the same birds when we see them handsome and spruce walking about our lawns, with their long glossy brown backs and mottled breasts, picking up worms and slugs. The young starlings and their parents seem to keep together and live as one family longer than most other birds, even after the former are well able to provide for themselves; and then, as autumn cold sets in. they suddenly take their departure, joining some convoy of starlings about to seek a pleasanter climate than ours; and we are not sorry to lose them, though the chances are that the same starlings will return again to our roof in the following spring.

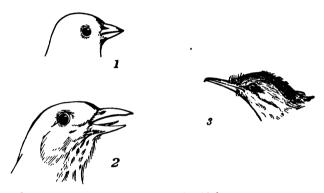
Most of the small birds which are dwellers in our gardens are called perchers, from their being accustomed to perch and roost on the branches of trees, and for this habit of life their feet are well adapted, the toes and claws readily clinging to a branch. Three of the toes are placed in front and one behind, while the tendons of the leg which pass into each toe are tightened by the weight of the bird's body as it roosts, so that even when asleep it is clinging safely to the boughs. Just a little difference is to be seen in the feet of such perchers as walk instead of hopping, the foot being spread out





¹ FOOT OF W. GTAIL, which walks.
² FOOT OF HEDGE SPARROW, which hops.

flatter, while birds which climb like the woodpecker have two toes before and two behind, which enables it to cling with its body quite upright as it searches the bark on the trunks of trees for insects or their eggs, or woodboring worms. The feet and claws of each bird are as suited to their mode of life as their beaks and bills, and vary greatly among the many varieties of birds. Even in the bills of such as visit or live in our gardens a difference is found between those who feed wholly on seeds and berries, those who feed on worms and snails, and those who live only on insects.



- ¹ HEAD OF CHAFFINCH, a seed-eating bird.
- ² HEAD OF MISSEL THRUSH, who lives on worms, slugs, and snails, and also on berries and fleshy fruit, such as cherries.
- ³ HEAD OF FLYCATCHER, who lives only on flies and other insects on the wing.

These little birds with their short necks, sharp-pointed bills, and feet fitted for clinging to the boughs of trees, form a great contrast to the duck, with its strong broad



FOOT OF SWAN.

bill, used half as spoon and half as spade, as it searches for food in the mud of its pond, and paddles itself about with its web feet; and still more unlike them is the stately swan, with its long flexible neck,

which it can send down deep into the water without

moving the rest of its body, while its feet are also suited for swimming by the webs of skin between the toes, which render them like broad oars.



Besides the pleasure afforded us by the notes and songs of birds, they are constantly supplying us with a source of interest as we watch their ways and doings. Even the sparrows that we see from our windows the whole year round are very amusing with their eager restlessness, and often rouse our attention with their squabbles among themselves for the possession of a bit of material for nest-building, or a scrap of food. They seem to have so strong a sense of the rights of property, when the property happens to be their own! We may notice a sparrow in the act of carrying off a feather towards the lining of his nest, pursued angrily by another sparrow, to whom it had perhaps originally belonged, and a fight in the air ensuing, the feather is dropped. As it floats down, it is perhaps captured by a third sparrow, who

carries it off in triumph. How odd, too, are the sly glances of a sparrow from side to side who has stolen a bit of cold potatoe, or sopped bread intended for the poultry, and which is too soft perhaps to carry off, and may have another claimant before he has time to eat it.

The house-sparrow builds a rather untidy nest, more curious for the variety of materials of which it is composed than for skill of workmanship. He benefits by his nearness to us in borrowing from us all manner of scraps that fall out of window, or escape from the sweepings of a house—bits of rag and muslin, and even ribbon and lace, are all turned to account, and woven in among the straw and twigs.

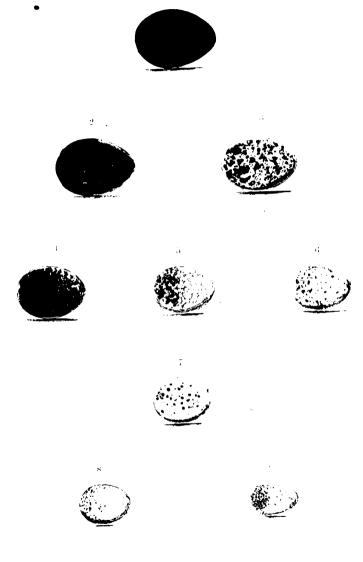
"Little thinks my lady fair,
As she goes by with mincing air,
How the pert sparrow overhead
Has robbed her gown to make his bed." *

The robin is, perhaps, our next most familiar friend and bird-neighbour, and though he sings all the year round, we most value his delicate little warble when other birds are silent. He seems to know that at last he will be listened to, as late in autumn he perches on some window ledge or balcony and gives us a succession of shrill yet perfectly sweet trills and quavers, showing off the utmost compass of his voice, and we like to see

^{*}Mary Howitt—whose charming poems about the lives and ways of birds help us to know, as well as to love them.



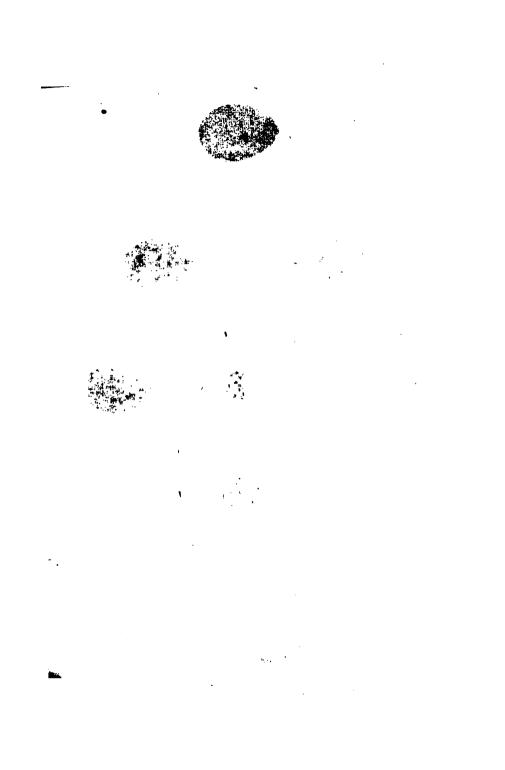
BIRDS' EGGS.



THE DWINGS OF STREET

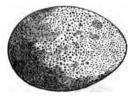
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the full black eye and enquiring side-long turn of the head as he listens himself to any sound as if trying to understand it. He is not afraid of us, and will eat any food we like to give him in winter, while in summer he lives on earth-worms, fruit and berries, and is quite independent of us. Many instances are known of robins coming inside a house, or outhouse to build, and they and their mates are so faithful to each other that it seems as if they paired for life. A pretty story has been told us of a fall of snow coming so late in spring that the snow lay heavy on the ivy-leaves against a wall, among which a robin family had their nest. The snow melted. and then froze again so as to form a veil of ice before the nest in which the mother and her young ones were crowded, while the father bird roosted at a little distance. When morning comes, what is the dismay of the latter, when wanting to give his family their breakfast, he finds that a hard and glossy barrier prevents his getting to them! He tries with all his might to hammer an opening through it, but in vain; and then flying off, he fetches back another strong robin friend, and the beaks of both succeed at last in making an aperture, so that the hungry little ones can be fed.

The wren also ventures near our houses and is almost as familiar as the robin, and sings too the whole year through, and on winter nights is glad to come and get the shelter of our roof, as he roosts in company with a party of other wrens, to keep each other warm. They begin to build very early in the spring, and make their nests in some hedge or evergreen tree for the sake of the shelter of its foliage. The nest is oval and rounded over at the top, with a small opening at the side through which the hen-bird can creep in and out, and soon as many as nine or ten small pinkish white eggs are laid in it, on which the hen sits patiently for about ten days, while her mate brings her food. When the little ones are hatched both parents feed them assiduously, taking care that each small fledgling gets its share. The egg of the gold en-crested wren, our smallest English bird, seems indeed a tiny object compared with that of the blackbird, which is the largest of the birds who build in our gardens.







Egg of Golden-crested Wren.

Of all our garden birds, perhaps the tit-mice are the prettiest race, from their delicate forms and graceful agile movements, and they are interesting in all their ways. The blue tit is not at all particular where he builds his nest, and if he cannot find a convenient nook among the branches of an apple or other fruit tree, will build it in a hole in a garden wall, and has even been known to make one in a garden pot, or the spout of a pump. The hen lays from ten to twelve eggs, and tor the little ones

when hatched the parents have to supply as many as six or seven hundred caterpillars in a day. Early in spring it is curious to watch the tit-mice as they are busy among the buds and leaves of trees where insects eggs and small caterpillars are to be found, and we may notice how, after beginning at the lowest boughs and travelling gradually upwards, a tit-mouse will make a thorough survey of a larch tree, examining every "green tassel" just put forth, now pecking at those above the bough, and now clinging with its body downwards as it clears those beneath it; and then with the agility and security of a slack-rope dancer, suddenly dropping to the end of a delicate twig, swings backwards and forwards, still pecking at each tiny bud as it clings.

The long-tailed tit-mouse is a lovely little bird, and



LONG-TAILED TIT.

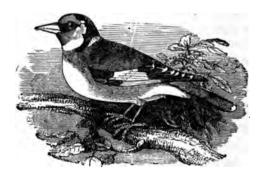
he makes a most exquisitely formed nest. It is so like the shape of a flask that in some parts of England it is called the bottle tit. The outside is covered with lichen. the silvery side of which is carefully placed outwards so as to give it an ornamental finish. Inside it has a soft lining of cobweb and innumerable small feathers for the eggs to lie on, and when the young birds are hatched they may be found by any one cruel enough to disturb the curious nest, all huddled together at the bottom like a ball of down. As they grow older they contrive to climb up to the opening of the nest at the top, and their little heads can be seen all in a bunch with the yellow beaks gaping for food. When older still, a family of tits will sit in a row on a branch outside the nest like children on a bench at school, waiting to be fed in turn. There seems to be a great attachment between these tit brothers and sisters, since they will keep together all through an autumn as one family, before each begins to shift for itself. We cannot perhaps talk of the singing of titmice, for theirs is but a lively note, as is the case with many other birds, but it serves as a sort of accompaniment to the songs of those who have more musical powers. Put into letters, the note of the tit is "chica-chica-chee-chee-chirr-r-r;" and as the mother bird sits at the bottom of the nest on her eggs, all in the dark, we cannot but fancy that her mate must now and then peep in at the top, and make this note of his express somehow an enquiry as to "how she is going on, and whether there are any signs of young ones coming out of the eggs."

Some of our garden birds seem to have an odd fancy

for pecking at blossoms and flowers and destroying them as if in mere wantonness. We must either imagine that they have pleasure in the mere picking of flowers, like very young children who gather buttercups and daisies, and the next moment let them fall again, or believe that birds have learned from bees to get at the sweet juices of flowers. We too often find a border of gay crocuses in spring cropped off by sparrows, while chaffinches will peck off the blossoms of a plum or cherry tree, till the ground is white with the torn petals.

In their search after food birds often seem to think about how best to capture their prey. A sparrow may be seen beating a bush with its wings to shake down the caterpillars from its leaves, and then will hop down to pick them up. Thrushes, who require larger game, and more solid food from the size of their bodies, will often find snails so shut up in their shells, that they cannot get at them, and overcome the difficulty by knocking the shells against a large stone, until a hole is made large enough to get at the soft body within. Other birds, as the woodpecker, are able to tell by knocking with their bills against the bark of trees, whether wood-boring grubs are within; and the little bird called the "creeper" runs up and down the trunks of larches and fir-trees like a mouse, in search of eggs and insects in the bark.

And all these birds do good rather than harm to us. There is no saying how we might not be over-run with caterpillars, grubs, slugs, and worms eating up our fruit and vegetables, nor how the air might be swarming before summer is over with flies, gnats, and other insects
on the wing, were it not for our small birds, who make
them their food, or feed their young with them. Even
the seeds of wild plants, if they were not the food of
many of our small birds, would cause the farmer great
trouble if they were left to fall on the land and germinate.
He might for instance have his fields quite over-run with
thistles, were it not for birds who eat their downy seed,
such as the goldfinch, who, while such an ornament to
our gardens, likes nothing he can find there so well as
the seed of the road-side thistle.



In some parts of the world where we have colonies, the want of small birds is so much felt, that many attempts have been made to send out different kinds from England in large quantities, in order that when set free they may increase and multiply, and their descendants spread over the country to consume the worms and caterpillars. To the settlers in such colonies the sight of an English sparrow, robin, or thrush, is a great source of delight, reminding them of their native land.

It cannot however be denied that there are some of our garden birds, who when the sun has ripened the fruit on our trees, are too fond of helping themselves to it. We find our juicy pears pecked away to the core, and our purple plums laid bare to the stone, while bunches of well picked stones are found hanging where cherries should be; but these latter we ought perhaps to consider as the property of our blackbirds, and to have been well earned by the part they take in our garden choir. They keep a close watch on our cherry trees from the time that they first come into blossom, and seem to know as well as any botanist how blossoms are needed for the production of fruit. How complacently they warble when the white petals having fallen off, green cherries are to be seen in their place. How closely they watch as the sun shines hotter and hotter, and the cherries swell and become fleshy, and white, and flushed with pink, and then redden and ripen. Just as we decide that it is time to gather our cherries we find they are gone,—for have not the blackbirds found out like ourselves that they were ripe, and are they not their own property? We resign ourselves to our loss, as we remember the pleasure which the rich and mellow notes of these choristers have given us, whose song contrasts so well with the more varied and florid notes of the thrush.

A naturalist who has studied for many years the various sounds produced by birds, tells us that he considers the mere chirping and twittering of birds to bear the same relation to their songs, as our talking does to our singing. He has observed, as indeed we all may do, that birds never actually sing when they are busy and have work in hand, whether it be nest building, feeding their young, or searching for their own food. At times their lively chirps and twitters seem as if they were talking to themselves or their neighbours about their doings and intentions, and it all sounds as if they were thoroughly in earnest and most deeply interested in what they are about, and eager to get it done. Only when at leisure after work is over do they really sing, and then it appears to be purely for their own and their mates' satisfaction and pleasure, and as if the production of sweet sounds pleased them just as it pleases human musicians to produce them. They generally perch on a branch near the outside of a tree or bush, so as to let the sounds go forth into the air un-hindered by the foliage, while they seem to enjoy bringing out all the tones they know, and once having begun will go on singing till disturbed by some movement or unusual sound. Perhaps the charm to us in the songs of birds, is that they appear to express only happiness and contentment, while the noises made by other animals sound as if the expression of wants or dissatisfaction, such as the bleating of lambs, the lowing of cows, the mewing of cats, and the barking of dogs.

Thrushes and blackbirds, wrens, robins, black-throats, and linnets are the choristers whose performances in our gardens are such a pleasure to us for a large portion of the year, and seldom all fail us; but if our gardens are far enough from towns, and in situations away from the noises of the high roads and the voices and tread of passengers, we may reckon on having in early summer the delight of hearing the song of the nightingale, whom we may consider to be our chief chorister. This little,



OUR CHIEF CHORISTER.

homely-looking, pale brown bird, has almost a world-wide reputation, since it is not only to be found in many warm and temperate climates, but has had its notes described and praised by the poets of all countries. It scarcely needs a description, however, to let us know when we are listening to the far-famed nightingale, so distinct and superior are its notes to those of any other bird. In some shrubbery in a garden, or some thicket near at hand, it may have built very close to the ground a nest for its young, where no eye but its own can see it,

and to which there is a cunning little passage among the tangled twigs and crowded leaves, the secret of which is known only to himself and his mate. Not far off. perched on some tall shrub or the lowest branches of a tree, when his family duties are over for the day, in the quiet of evening, but more often after other birds have gone to roost for the night, he will pour himself out in song. All manner of notes and varied trills will gush forth from his little throat. It is as if each passage of his song were composed at the moment, just as his fancy pleases him; but no! for the whole makes up what we have heard before, and is peculiar to every bird of his kind; and as the singer pours out the lovely strains, it tells us not only of his gladness and satisfaction in living, but seems to our fancy, as it rises up sweet and almost solemn into the still night air, as if it were a hymn of praise and thanksgiving for all the joys of his little life.

We conclude our history of some of the birds which frequent our gardens and delight us with their notes and songs, leaving much which is still to be told of their lives and natures; but we shall be satisfied if our chapter shall succeed in making its young readers feel how they will in future like to observe and discover for themselves more about them; and this they can easily do. For, far better than any written histories of birds is that which we all can observe for ourselves of the lives and ways of those who inhabit and frequent even small gardens; and still better will it be should such observations lead to an interest being felt also in the

birds of our fields and woods, our rivers, lakes, and sea shores. In all these almost countless tribes and families of birds, more and more striking proofs are to be found of the wonderful tenderness of nature and strength of instinct which has been given to them, and how every part of their curiously varied forms, and every peculiarity in their habits, is suited to the places where their lives are led, or we may say—how powers have been bestowed on them by the great Giver of their lives, to enable them to adapt those lives to all that surrounds them.



Young Thrushes.

CHAPTER VII.

AFTER SUNSET.

ow much of the life and movement and various sounds of a summer's day in our garden seems to have come to an end with the setting of the sun! The last

bee has by that time returned to the hive with its load of honey; the last ant has hurried across the garden paths, and gone down to the subterranean city; the butterflies are all gone, a lull has come in the songs of birds; but even when twilight begins to creep on, and all the golden and rosy streaks and flushes have faded out of the western sky, there is still some life to be found, and the ways of many creatures are still to be noticed. Swarms of midges and gnats are flying in the air, seeming to dance up and clown chasing each other, which were born perhaps only an hour before, and whose short lives will be ended before the morrow. We may watch the little sharpbilled fly-catcher darting in among them, and returning each time to the exact spot whence he came, and continuing his sport until his slender beak is bristled with the prey he is careful not to swallow, but is going to take home to his young ones. We hear the deep-toned droning hum of beetles, who fly so heavily and sleepily, while sober moths take the place of gay butterflies, flying with a lazy, slower flight, and hovering before the few flowers which keep open after sunset, and as they hover dip their long honey-tubes into their nectaries, without poising on the flower. When they do rest, too,



they are different from butterflies. Their antennæ or feelers are bent down under their heads, while their soft wings are folded on their backs, and not lifted up and placed against each other like those of butterflies. It would seem as if they needed the cover of their wings in the cool evening air; and the texture and colour of many of them are not very unlike that of grey and drab great-coats. Underneath these wrappers, however, they have often beautiful hind-wings, on which are lovely spots and patches of black and white or crimson and orange. The bodies of moths are generally more thick and clumsy-looking than those of butterflies, and are mostly covered with a longer and more shaggy down, and

are not narrowed in at the waist like those of butterflies. Their feelers are short, and have no knobs at the end, and are sometimes feathered very delicately, and stand out from the head like flat plumes. It is the difference



of the feelers in this respect which makes it easy to detect a moth from a butterfly in most instances. Very few moths, too, fly by day. They seem to shun the bright sunshine, and to be altogether a more soberminded race than their relations, the butterflies. Some of them, however, are very magnificent creatures in the colours and markings of their wings, and are no way behind the butterflies in beauty. The Emperor moth, for instance, has its four wings most grandly spotted and variegated with shades of brown, red, and grey, and deep orange. On each wing is a round black eye, encircled with rings. It begins life as a caterpillar of a most delicate pale green, with pink spots upon it. The Tiger moths are also a very handsome family of moths, and are so called from their wings being spotted with black. white, and yellow, like the skins of tigers. What are called the Hawk-moths are some of them very large and handsome, with wings curiously marked and spotted with

black and brown. One of these, named from the spots on its wings, the Eyed Hawk-moth, is a very handsome and conspicuous creature, and might almost be taken for a bird, which perhaps it has a fear of happening, since it has a way of arranging its body and wings while it sleeps so as to look very much like a bit of twig with some dead leaves on it. The caterpillar is a large, hairless, fleshy creature, with a horn standing up at the end of its body,



EYED HAWK-MOTH.

and feeds on particular trees, such as the lime, the poplar, and the elm, etc. It burrows in the ground when it changes into a chrysalis, which is dark brown, and might easily be taken for a bit of rounded stick. The pupa or chrysalis of a moth is in fact never angular like that of a butterfly, but smoother and rounder. The most curious moth that we ever see in our gardens is what is called the Death's-head moth, on account of the



markings on its head, which have been fancied to look like a skull. It is, too, a dark and gloomy-looking creature, and many strange stories are told of it. Among others, it is said that in all its three states, as caterpillar, chrysalis, and moth, it utters a squeaking sound. This can often be heard from the moth when it is caught and held in the hand, when it sends forth a sharp cry like a mouse, but how it produces this sound has not been dis-

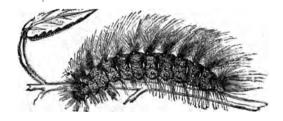


CHRYSALIS OF MOTH.

covered. This is the moth which is said to be so fond of honey, and will creep into hives, and with its short thick trunk suck out honey from the cells of a honeycomb, and we have told in our chapter on bees, how cleverly the latter sometimes contrive to prevent the entrance of the great-bodied thief, by constructing narrow winding passages at the entrance of the hive. In other hives it has been found that after stinging the intruder to

death, the bees have covered up its body with a coating of propolis, or bee-glue, as if to embalm it like a mummy. All these large moths are a great contrast to other races of moths who are very small and most delicate in form. Some of these have transparent wings, and others are like mere tufts of white down or snow flakes. The Twenty-plumed moth which we sometimes see on our windows has its wings formed of separate feathers, somewhat like those of a bird, but only fit to make pens for the use of fairies. We may judge of the infinite variety of moths to be seen after sunset—a few only flying by day—when we are told that in England there have been found and named as many as nineteen hundred different species.

Most of the large moths have also very large caterpillars, some of which are smooth and fleshy, and others are covered with thick hairs, as the caterpillar of the Tiger-moth, called "Woolly Bear," from its curious appearance.



We all know too well the strange attraction which the flame of a candle has for these night-flying moths, and to which we can seldom prevent their falling victims. It is said that if on a warm summer night we were to leave a lighted candle on a table near an open window, as many as twenty species of moth would be sure to be attracted to it before dawn. Among such are the "Swallow-moths," so called from the form of the wings,



SWALLOW-MOTH.

which are prettily streaked with brown, white, and grey. The caterpillar of one of the species having two humps on its back, has caused it to be called "Dromedarius." A pretty moth called the Lackey-moth has been so called from



LACKEY-MOTH.

the gaudy sort of livery worn by the caterpillar, which is often found in our gardens; while another little moth,

the Poplar-moth, is remarkable for visiting us as late in the year as December. The caterpillar is found in June, feeding on poplar leaves, and then, becoming a chrysalis in July, remains in that state till December, when the moth comes forth—the very last of its race to make its appearance in the whole year.

The way in which moths are attracted by the light of a flame was thought a great deal of by the ancient Greeks, who made no distinction between them and butterflies, calling them both Psyche, which also meant



the soul.* They had all manner of curious fancies and notions about the strange and irresistible impulse which the moth has to so destroy itself, likening it to the way

^{*} See Third Chapter, on the Butterfly.

in which the soul is consumed by fiery passions, and inventing many stories about Psyche, which we may think perhaps more absurd than poetical, though they represented many of them very beautifully in sculpture and painting.

Moths may seem to us to be but an idle and uninteresting sort of insects, not so lively as butterflies, and with none of the talents and powers of ants and bees, and useful only in providing for the continuance of their race by the laying of eggs; but among the caterpillars of moths we find a number of most curious powers, which they exert in the construction of places of shelter and concealment, in which they are safe from being captured by birds, or where they can be unseen and undisturbed whilst undergoing their change into the pupa or chrysalis state. Among these clever works are those of the leaf-rolling caterpillars, many examples of



which we may find among the trees and plants of our gardens. Different caterpillars have different methods

of setting about the task of making their place of shelter. but all make use of the power they have of spinning silken threads, with which they fasten together the portion of leaf which they fold or roll up. In some the leaf is merely closed together and fastened, while the caterpillar lies along the mid rib; in some the side of the leaf is rolled round into a long tube; and in others the point of the leaf is rolled round several times, and fastened with silk cables both within and without. Other caterpillars pack together a bunch of leaves, winding the silk thread around them much as we tie up a nosegay with a string. Others make little bowers of leaves, in the midst of which they live and eat, concealed from the prying eyes of birds. The caterpillar of a very pretty little chocolate-coloured moth, who lays its eggs on the lilac tree, one egg only on one leaf, begins directly it is hatched to roll up its leaf into the form of a tunnel or gallery, where it may feed in safety, and then moves to another leaf when it has eaten up its dwelling-place. begins to roll up the leaf from the point, and as the leaf is elastic, and has a tendency to spring back again, the little creature is obliged to fasten the roll with its silken cable as it proceeds, and then, when the roll is finished, ends by attaching little cables outside along the whole length of the tunnel. This seems as wonderful on the part of the little new-born caterpillar, if we come to think about it, as if a very young infant, soon after its birth, were to set about rolling itself up in a large piece of carpet or matting three or four times its own length, fastening it with cords inside and outside, so that it could not come unrolled again, and all the while somehow manufacturing the cords used in the process!

The caterpillars of some other moths display the talents of carpenters and masons, some of them living upon the fibre of wood, and while they eat into the bark of a tree making themselves galleries or cells, in which they change into the chrysalis state. This is done by the caterpillar of the Goat-moth, which is a large moth often to be met with in many parts of England. Other caterpillars of moths will file off fine raspings of stone with their sharp cutting jaws or mandibles, and sticking these together with silky matter, form little stony cases around themselves whilst going through the change into the pupa state.

The most curious of the moth tribe, however, is one which although it will live in England, cannot be called a native, viz., the moth which is the perfect insect of the caterpillar which we call the silk-worm. When we think of the vast amount of manufactured silks and ribbons, with which human beings in all parts of the world clothe and adorn themselves, and which is used in the hangings of the mansions of the rich and the palaces of the great, it is almost difficult to believe that it can be all produced from a caterpillar little more than two inches long—that all the cargoes of silk brought to be woven into such fabrics from India and China, and all that which is produced in Italy, and manufactured there and in France into silk and satin, gauze and velvet, is

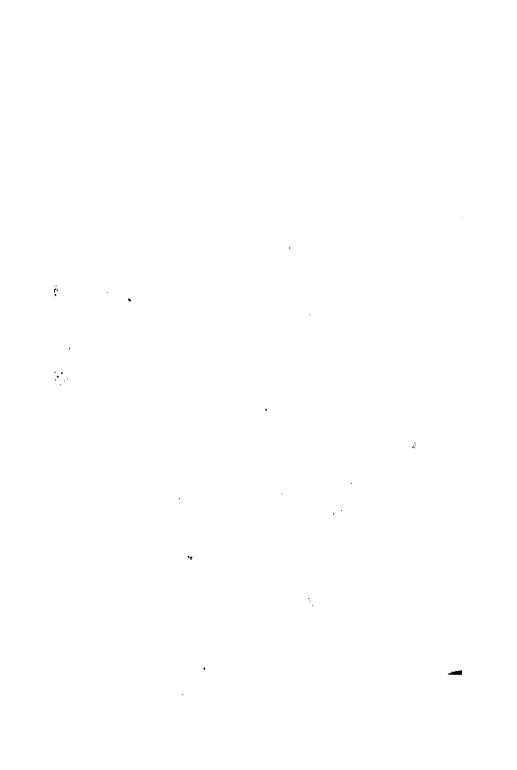
at first but the exceedingly fine thread spun by the caterpillar of a moth, in order to make for itself a kind of shroud or garment, in which it may hide itself while it undergoes the change into a little shapeless pupa or chrysalis. In most warm countries this same caterpillar is found, and we know not, for how many thousands of years the little creatures spun their cocoons, and changed into pupæ and then again into moths, eating their way out from their silken garments, and leaving them upon bushes and boughs of trees, without anyone thinking of turning the empty little yellow pods to account. Pliny, the Roman writer and historian, tells the story of a young Greek girl called Pamphila, of the island of Coos, being the first to discover that she could wind the fine thread off from a cocoon, and that this led to its being spun together and then woven into a shining and flexible tissue. The story may be true of silk so turned to account in Greece, but there is no doubt that the industrious and ingenious Chinese people were the first to make use of the cocoons of this kind of caterpillar. They spun and wove the fine thread of the caterpillar thousands of years before it was brought into Europe, and even then the delicate fabric was so choice and dear that it is told of a Roman emperor that he would not allow his empress to have a robe of silk, on account of the expense. It helps to give us an idea of the fineness of the silk thread in its natural state when we are told that in a single cocoon there are as many as nine hundred yards of it, while it takes the cocoons of two thousand silk-worms to spin a pound of silk ready for weaving.

The silk which we use and prize so highly depends, however, after all, on the leaf of the mulberry tree. Unless the caterpillars are fed on these, no valuable silk, capable of being manufactured, is obtained. We may notice what a sticky, glutinous juice, is the sap of the mulberry leaf, and must think of this being, as it were, the foundation of silk, after undergoing a change while digested by the silk-worm. The Arabians have a proverb which says:—

"Patience! and the mulberry leaf becomes satin"-

and, we will add—"helped by the caterpillar, who eats it, and the ingenuity of human beings."

When the shades of evening have deepened, and made the outlines of trees and plants quite indistinct, and when the last note or twitter of birds is silenced. and we fancy them all comfortably settled on their boughs for their night's roosting-leaving, of course, the nests to the little ones, or to the mother birds who happen to be sitting on eggs; when all is very still, and we are perhaps watching some little star that has twinkled out of the dark grey sky, we are startled for a moment by what seems like the rapid flight across the window of a bird with a broken wing, so irregular is it and "A bat!" some one exclaims; and before the words are uttered another flies by, or the first returns again. We know not whence they come, nor where they are going; but we presume that they are after the beetles and moths, or other insects to be met with at



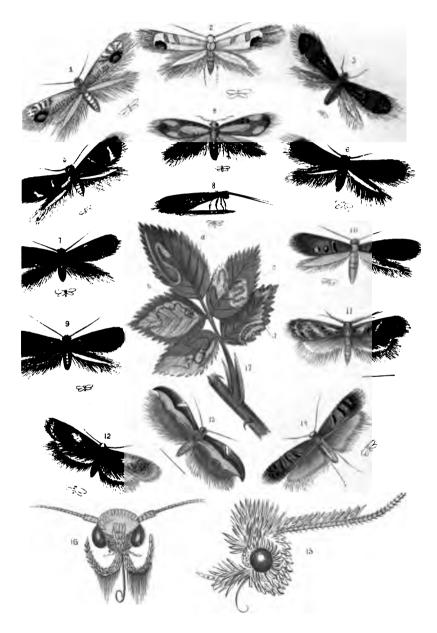
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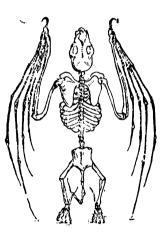


MOTHS OF LEAF MINERS.

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that time of evening. It may be that there is a bat's nest in a wall in some old farm buildings or stables not far off, or in the village church tower; but wherever it is that they live, the secret of their hiding-place is well kept, so that we are obliged to go to books, or listen to the story of some chance person who may happen to have seen a bat's home, and found his family in it. We may, too, have a stuffed bat, or be able to look at the various species of them to be found in a museum; and as our own observation of them may have been confined to watching their curious, flashing, uncertain flight, we shall find it very well worth our while to examine the curious body of a bat, and learn all we can about their life and ways. It flies, and yet is very far from being a bird! It has wings, and yet it has no feathers. not lay eggs, but brings forth its young alive, and suckles them as does a mouse or squirrel. Its old English name was Flittermouse. The Germans call it Fledermaus; the French Chauve-souris, or bald mouse. In Latin it is called Vespertilio, because it comes forth and is seen in the vesper, or evening. In Greek it is called *Cheiroptera*, or hand-winged; and all these names, especially the last, help to explain the nature and form of a bat. It is, however, when we see its skeleton, that we can best understand its real structure, for we perceive by this that though it might be said to have two hind legs and two wings, yet that the wings are really like arms and hands —long arms, very long fingers, and short thumbs—while its two hind legs are short, and are provided with feet,

which have also fingers and thumbs, the thumbs of both hands and feet being like hooks. When the skeleton is clothed, as in the living bat, a soft down-covered membrane is stretched all down each side of the body, covering the bones of the arms and hands, just as the silk of an umbrella covers the whalebone or steel ribs of



it, and just like an umbrella or large fan, this membrane can be folded up when the wings are not wanted for flight, and packed up on each side of the body like folded fans or shut-up umbrellas. Besides thus using its fingers in flight, a bat makes great use of its four thumbs, since they are provided with a kind of hooked nail or claw. When he sleeps, he gathers up his wide-spread wings around him, and hooking himself by his hind feet

to some object head downwards, so spends, not his night, but his day; for since bats fly by night in search of food, they must sleep during the day.

Still more curious is the use the bat makes of his thumbs in walking, for he uses his fore thumbs instead Packed up into a brown ball, he creeps along with the help of these short thumbs at the joint of the wings, his large ears standing up ready to catch every sound. The tip of the tail of a bat is also very hard and stiff, so hard it can be used to help them in climbing, while in flight it assists them as a rudder in steering their course. The muscles of a bat's wing are very thick and strong, since they keep on the wing through a great part of the night, only ceasing to fly backwards and forwards in search of prey when owls come forth, who in their turn prey upon mice and bats. They seem constantly to dart from one spot to another, and yet can be noticed at times turning round in the air in pursuit of an insect. A mother bat brings forth only two young ones at a time, and is very attentive and careful of her offspring. She will fly about with the greatest ease with her little ones hanging to her breasts, and while at home wraps her large wings round them as she nurses them, much as a human nurse will gather her shawl round a baby. Some people have been found to take pleasure in taming bats, and have even trained them to take flies and other food out of their hands, but even then they seemed to like to eat in private, and would draw their wings over their mouths, and eat what was

given them as if behind a veil. They would, too, retire to the darkest corner of the room by day and only come out when it was dusk, as if light were painful to them. One of these trained bats was observed to be very neat and tidy, and seen to comb the hair on his back very carefully with the fingers of his feet, making a parting down the middle as a lady will do.

All the senses of a bat are very acute, sight, hearing, taste, smell, and touch; but to account for the manner in which a bat contrives to avoid knocking against anything as he flies, it has been maintained that he had a sixth sense, which gave him this power, rendering him conscious of an object being near, although he could neither see, smell, touch, or hear it. To make sure of this, most cruel experiments were tried by one naturalist, who put out the eyes of a bat, and covered over his whole head, and yet found that it could fly about a room without touching anything, and go in and out of a door without touching the sides of the doorway, and make its way down a narrow passage with a turn in it, all without striking against the walls. He even hung threads from the ceiling of a room, only wide enough apart for the bat's wings when extended to pass through, and found that it could do so without coming in contact with them. said, therefore, that bats must have a sixth sense; but other naturalists think that they may only have great sensitiveness in the membrane which covers their wings, and that this may account for their being able at all times to steer their way in the dark.

Our English bats are very harmless creatures, and cannot be said to do us any harm; but terrible stories have been told of a kind of bat, called the Vampire. found in hot countries, which is said to suck the blood of human beings after fanning them to sleep with its great wings. A traveller, to prove if this were the case, had the courage when a Vampire bat came to his tent at night, to lie still on his back and bare his chest, in order to see what would happen. After flying over him backwards and forwards for some time, while its wings fanned him most pleasantly, the creature settled at last on his chest, and suddenly piercing the skin with one of its sharp thumb nails, it began to lick up the blood which flowed from the wound. The traveller then thought it time to capture and kill the Vampire, who after all had not done him much harm, since no poison had been injected in the wound. Such facts as these greatly exaggerated, together with their way of living in gloomy places, such as caves and hollow trees, and old ruins, and their habit of coming forth only in the twilight, have caused bats to be looked upon as rather mysterious and dismal sort of creatures, only fit to attend on witches and hobgoblins, and such imaginary personages, so that we do well to learn that their lives are, after all, spent much as those of other small creatures, in the search after food, and in tenderly rearing and protecting their young. We may remind ourselves, too, that the "delicate Ariel," who was a good and beneficent spirit, performing so cleverly and zealously the commands

of his master, Prospero, describes himself as making use of them in his journeys through the air, when he sings—

"On a bat's back do I fly, After sunset, merrily."



CHAPTER VIII.

INVADERS, VISITORS, AND SETTLERS.



T may seem strange that we should have to relate, that our gardens are sometimes invaded by a wild species of quadruped who comes into them at times, seeking, as do most wild beasts, that which it may devour—

scrambling in the first instance over our walls, or making its way through holes in our palings, or gaps in our hedges, in its search after food. It is of course not a lion, or tiger, nor even a lynx or fox; but however it may differ from all these creatures in its outward appearance, it has really much that is like them in the structure of its body, for all quadrupeds are like each other in the form and arrangement of the bones which compose their skeletons; just as in the construction of houses there is much that is alike in the beams and rafters, however in their external appearance, they may differ from each other. In the skeletons of all quadrupeds is found the back-bone, or spine, composed of many separate vertebra, or small bones fitted into each other, so as to make the whole flexible, with the skull at

the end, which contains the brain. Branching out from the back-bone, or spine, are the ribs, which bend round and protect some of the most tender internal parts of the body; while in the bones of the four legs, there is much alike in every quadruped both in their form and arrangement as well as in the muscles which move them in life. It is therefore in size that the invader whom we are going to describe, differs most from any other quadrupeds, that roam wild about the forests and deserts; and in this respect the difference is very great. In the skeleton of the elephant, for instance, which is the largest of all quadrupeds, we know that it is composed of thick, heavy solid bones, almost as hard and strong as if made of iron or stone, while the whole skeleton is perhaps two and a half yards in length; and in the case of the animal which sometimes invades our gardens, the bones of which it is composed are as fine and delicate as if carved in ivory, and the whole being but about two and a half inches long, it could easily lie in the palm of our hand—for the creature of which we are speaking is but a mouse, the very smallest of all quadrupeds.

Two or three different kinds of mice come to us at times from the fields, and if they find that they can supply themselves with food enough among our vegetables, and such seeds and fruits as are to be found lying under our trees, and especially if we happen to grow Indian corn, or have some bushes of hazel-nuts and filberts—if only such delicious provender as this is to be reckoned on which can be stored up, they will become settlers

with us, and make their nests in some sheltered nook beneath the root of a tree, or under a tuft of grass, or in some cranny in a wall, and lining it carefully with moss and dead leaves and hay, will there live and bring forth, and rear their young. As they have usually as many as six or seven young ones at a time, and two or three families in a year, it will make all the difference to us and our gardener, when such invaders become settlers.

The mouse which most often lives in our gardens is the wood mouse, or as it is sometimes called, the "Longtailed Field Mouse"*-a pretty gentle timid creature after all, with large bright eyes, and broader and rounder ears than those of the house mouse, and with a tail nearly as long as its head and body. Like the squirrel, it lays up stores of food for the winter-seeds, nuts, and grain, etc. It probably sleeps a good deal during the very cold weather, and yet may be seen venturing forth even when the snow is upon the ground to forage for food if its store is becoming exhausted, and rather than starve will burrow down to our crocus and snowdrop bulbs and nibble them away. Since it feeds principally on vegetable food, it lives on good terms with the other inhabitants of our gardens, and has only to fear being caught by some stray cat or owl who is on the look out for mice and moles. It is curious to think of the quiet snug life which our little mice settlers may lead,

^{*} See last page.

all the winter feeding and sleeping alternately in their warm nests, and yet cases may arrive when, perhaps, the winter being longer than usual and their storehouse becoming exhausted, and nothing to be had in the garden that will suit them, they will make their way out beyond its boundaries again, and get into some neighbouring wood or plantation, where beech-nuts and acorns are still to be found in the dead leaves at the foot of trees. A near relation of the wood mouse, is a somewhat still smaller animal, and is likely only to pay us very short visits. It is called the harvest mouse, and living principally on grain, constructs for itself a nest amid the stalks of corn, like a round bag hung among them, formed of leaves and grass woven together. entrance into this curious nest is contrived so as to close as with a spring after the owner has entered it, or when he leaves it, filled with his young ones or with his store of food. This mouse is able to catch hold of objects, such as a twig or stalk of corn, with the end of his tail, like an opossum, so as to swing himself from one twig or stalk to another. Mice have such large families, and increase their numbers so fast that a naturalist who wanted to ascertain how fast they would multiply, put a pair of harvest mice into a large box, together with a quantity of grain, and on opening the box three or four months afterwards found that there were one hundred and twenty mice in it.

The mole is another quadruped which is sure to invade our gardens, or pay them occasional visits, though we do not often meet with him above ground. In a neighbouring field we may perhaps see the little hillocks of earth which moles bring to the surface after burrowing out the subterranean passages which they form, and even in our own gardens such traces of them are to be found when they make their way under our walls and fences, in search of earth-worms, which form their principal article of food. From time to time we do, however, get a sight of moles, and though we may fancy them at first to be ugly and shapeless creatures, it is worth our while



to examine them well, that we may learn how curiously their form is suited to their manner of life. First of all, the long shapeless body is covered with a most smooth and velvet-like fur, which will turn any way, so that while groping about underground it enables the creature to slip easily through the passages it burrows out, either backwards or forwards. The head is joined on to the body without any neck, and has a long flexible snout, which penetrates the earth like a ploughshare, while its short fore-legs have broad paws like fat hands turned

outwards, with five fingers and sharp pointed nails, just fitted for first helping to rake away the earth, and then to throw it back on each side as the creature ploughs its way along. Since the mole spends its life in the dark, its eyes are very minute, and perhaps enable it to see with a very little amount of light, while its ears are scarcely visible at all.

Though the mole travels so much underground, and does not require shelter like most other animals, it has still a home of its own. In the centre of one of the largest hillocks, or mole-hills, will be found its nest, and nothing can be more curiously or artfully constructed than these abodes. They are formed like little fortresses, composed of two round galleries, one above another, communicating with each other by five upright passages, while other "runs," or tunnels, branch out from the lower gallery in every direction, and extend over a considerable space. In the centre of the fortress is the principal apartment, in which the creature dwells, and from which, if attacked, he can make his escape by any of his secret passages. He is not obliged to be always burrowing his way through the earth in search of food when such a system of tunnels has been executed by him, but can use it as a sort of hunting-ground around his fortress; and we may fancy the proprietor of such a territory running about his underground passages in search of worms, and living rather at ease when once he has formed his abode, and dug his tunnels that communicate with it. He has only to be careful not to show himself above ground too

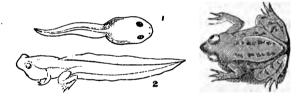
often, if an owl happens to dwell in his neighbourhood. and to beware of the traps of the mole-catcher, who knows so well all his ways and habits. When the creature has to bring forth and rear its young, it forms a different sort of nest in one of its raised hillocks, carefully constructed with drains, so as to carry off moisture, and which nest is supplied with plenty of leaves and warm materials for bedding. Moles do us very little harm in our gardens, since they do not eat vegetables, and do eat many animals of which we might otherwise have too many. The underground passages they make seem also to break up the soil and help to drain it. Earth-worms are said to be so afraid of moles, who prey on them so constantly, that no sooner do they feel any shaking of the ground about them, like the approach of their enemy, than they wriggle up to the surface of the earth; and it is a still more curious fact that those birds who also make worms their food seem aware of this, so that thrushes and lapwings will be seen knocking the earth with their bills, and stamping with their feet round the holes of worms, in order to bring them up, when, of course, the poor worm becomes the prey of the bird, instead of the imaginary mole. Sometimes the soft velvety skins of moles are used to make gloves, and pouches, and purses, and we have even heard of a gentleman wearing a waistcoat made of mole-skins.

And now we must describe, what may be thought perhaps to be the very ugliest of all the dwellers in our gardens, and yet it is one who has much in its life that is

It has, in fact, a sort of double life, being very curious. at first an inhabitant of some pond in the neighbourhood of the garden where it is found, in form very like a fish, and feeding on water plants, and afterwards becoming a land animal, and requiring for its support flies, slugs, small beetles, and worms. We know him best when, as a frog, he sits under the shelter of some large cabbage or rhubarb leaf, or among the strawberry plants in our gardens, careful not to expose himself to the heat or light of the sun, for he likes shade and dampness as much as the "Slow One" of our first chapter; in fact, his life depends on keeping his skin moist, and he would die were he to be exposed to the heat of the sun, so as to have his skin dried up. There he sits grave and ugly; his prominent eyes on the look out for any living creature on the wing that may come near, and with his great mouth ready to open like a trap, and his long tongue prepared to dart out to capture the prey!

The frog, though it has four legs, is not classed with quadrupeds, but with reptiles. It is said to be amphibious, which means having "both lives"—one on land and the other in water. In early spring the eggs of the frog may be seen in large clusters in ponds, like transparent beads, with a black dot in the middle, and in April the creature we call a tadpole is hatched from them. At first it is like a tiny fish with gills outside its head, but these soon disappear and nothing is to be seen but a round body, like a head and stomach in one, and a long tail (Fig. 1). It feeds on the plants which

grow in the water, and especially on the green duck-weed which covers the surface of ponds. It has little hooks on its jaws, to enable it to bite the leaves, with a sort of tube or sucker on its lower lip, by which it hangs to floating plants. When the tadpole is about six weeks old, a pair of legs begin to make their appearance near the tail, and by-and-by another pair come out near the head (Fig. 2), the tail disappears and the animal is then a young frog. It makes its way out of the pond and begins to live on flies and other living creatures; many other changes having come about in its body, which enables it to breathe air and digest a different kind of food. As a great many young frogs leave their native



ponds at the same time, and make their way to fields and gardens, the ground will seem alive with them sometimes, and people have been known to fancy that a shower of frogs had fallen, but it has only been the migration of thousands of them, obeying a natural impulse, and turning their backs on the place of their birth, begin to exercise for the first time their power of leaping and crawling. Frogs have wonderfully

strong muscles provided for the movements of their legs, since they have so many different motions to perform with them-swimming, walking, and leaping. Even after a frog has its four legs, it is a great swimmer, and its feet are webbed with skin between the toes, like those of a duck, for after spending the greater part of the year on land it returns to its pond again late in autumn, and when winter sets in, buries itself in the mud at the bottom and remains there in a torpid state until spring returns. The power of a frog's muscle is shown most in its leaping and hopping, since it can jump into the air as high as twenty times its own height, and at a single leap go the distance of fifty times its own length. The bones and muscles of a frog's hind legs are said to be very like those of a man, but we cannot very well fancy a man being able to perform such a feat in the way of jumping or leaping. The tongue of a frog, which it uses for catching its prey, is very long and narrow, and is placed in its mouth quite differently to that of most animals, since it is fastened within the front of the lower jaw, with the end lying towards the throat—just the reverse way to that in which our own tongues lie in our mouths. It is also covered with a sticky kind of liquid, to which the flies, as they are caught, adhere, and not being able to escape, are drawn into the frog's large mouth and sent down the throat. Watch as we may, however, it is almost impossible to see the tongue of a frog as he is fly-catching, so rapid is its motion.

Frogs grow very slowly and live very long. They are nearly related to toads, who pass through the same changes in their lives, and are *amphibious*, or "bothlived." A toad can be known by the small bumps on its skin, and by its crawling instead of leaping. There have been plenty of people, who though they might not perhaps have found beauty in them, yet liked to make pets of frogs and toads. We have known a family, who had a large pet frog, called "Jacob," who was supposed to be fond of music. When on summer evenings the drawing-room windows were left open and playing and singing likely to be going on, a "flop" would be heard



on the floor, and it would be found that "Jacob" had come in to listen to the music; and the greatest care was taken that no one trod on him, or set the legs of a chair on him, while some kind of supper would be found to suit him before he took his leave. Late in the autumn he and his fellow frogs will have returned to their native ponds, where they spend the winter in the mud

at the bottom, and in the following spring have a concert of their own, since frogs at that time of the year send forth their curious croaking, the chorus often beginning in the twilight and continuing far into the night. In America there is a species of frog, whose croaking is not only louder, but also more musical than that of our frogs, so that, as in England, we go out sometimes after dark to listen to the nightingales, people there will go out to hear a frog concert.

We should be neglecting to notice a large portion of the living creatures which are to be found in our gardens, were we not to tell something about the curious and beautiful Beetles, some of which are settlers, and some only visitors to us, but of which many species may be met with even in the course of a single summer's day. It would, however, take the whole of a little book like this were we to describe even the appearance of many of them, so greatly do they vary in shape, form, colour, and size, though in their habits and mode of life there is not so great a difference.

Beetles belong to the class of insects to which is given the name of *Coleoptera*, a word which means wingsheathed, owing to their having besides the wings used for flight, another pair of hard, opaque outer wings or wing-cases, which cover the former from sight, except when the insect is flying. The pair of light gauzy wings are folded up when the beetle is at rest, and the thick sheaths close together over the body, like valves fitting so exactly that they often seem like one piece, and we are apt to forget the very beautiful and delicate transparent wings which are folded up under their hard shiny coats, ready to be expanded and bear them up into the air.

As we look at a beetle at rest, we can easily perceive that there is not the narrow part between the chest and the stomach which we see in many insects, but that the head and chest are joined immediately on to the rest of the body.

All beetles have but two eyes, but these are what are called compound eyes, and are made up of many small eye-lets, which no doubt supply them with very acute sight. As their food is very varied, their mouths are fitted for several ways of getting at it, and in different kinds of beetles are suited for cutting, gnawing, tearing, or chewing—but never for sucking or for lapping up, like those of the fly and bee. And they need all these different little instruments for feeding themselves, since some prey on the flesh of dead animals, some on rotten wood, some on wood that is fresh and growing, some on the roots of grasses and plants, some on grain, and some on leaves—while the most dainty of all would seem to be those who feed in the petals of flowers. pass through the same changes and transformations as other insects. At first the form is like that of a grub or larva, like a short thick worm, its body very soft, but with a horny head, something like what it afterwards has as a perfect beetle. In this state it prepares for the change into a pupa or chrysalis by contriving some kind

of defence around it. Some have been hatched from eggs previously laid in the earth, and when about to undergo the change, they hollow out the earth around them so as to form a little cave. Others make a sort of cocoon, by joining together particles of earth with web or sticky matter. Those which live in wood have no need of cocoon, but change into pupæ in the hollow they have made while feeding on the fibre of the wood, while some, which feed on plants, hang themselves in round silken cocoons from the leaves or stalks of it.

We have no English beetles which are to be compared in splendour with the Diamond-beetle, which is found in tropical countries, whose wing-cases, when seen in the microscope, seems studded with brilliant gems, yet many of our garden beetles are very beautiful in form and colour in their delicate antennæ and legs, and in the hues of their wing-cases. We find in the centre of our roses the beautiful Rose-beetle, with its body of a bright emerald green burnished with gold, and who seems as if conscious of the becoming contrast of the glowing pink or crimson of its cradle to the hue of its own body. The first state of life of the insect is very different to the nature of its favourite food, since the grub is found in decayed wood and ant-hills. Perhaps no beetle is more unlike the Rose-beetle than the great brown Cockchafer, which we sometimes encounter in our gardens in the evening, when it will strike against us as it flies, as if its sight were imperfect; from which circumstances is supposed to come the saying, "As blind as a beetle."

When the female Cockchafer wants to lay her eggs, she digs a hole in the ground about six inches deep and there leaves them, and by-and-by comes from them a white or greyish-coloured grub, which feeds on the roots of plants for years. It then goes still deeper into the earth and changes into a pupa or chrysalis, and at last makes its way out of its subterranean abode a perfect Cockchafer.

Another species of beetle with which we are all so well acquainted is the little Lady-bird, or Cow-bird, as it is called in some counties of England. There are several kinds which frequent our gardens. One with two black spots on its round and scarlet wing-casesanother with five spots, while some are black spotted or blotched with red. It is a useful insect in gardens, because it feeds on the aphides or plant-lice, which destroy so many vegetables. The largest of all our English beetles is the Stag-beetle, which very rarely pays us a visit, but who has such stag-like horns standing out from the front of its head, that we are sure to know its name. The Burying-beetle is, perhaps, the most curious of its race in its habits. It not only lives on the flesh of dead animals, but after it has feasted on them, the female lays her eggs in the same body, in order that the grubs, which come from them, may have the flesh of the creature also for their food. To secure this the beetles bury the dead body of the bird or mole which they have found, before they begin their feast. First they dig around it a sort of trench, and then gradually hollowing out the earth beneath it, pull the body down. While the little sextons are invisible, the body may be seen gradually sinking down into its grave.



FEMALE BURYING-BERTLE.



MALE BURYING-BEETLE.

Very nearly related to beetles is the earwig, which has also its two sets of wings, with the gauzy pair folded up like fans under the sheath-wings. The grub and chrysalis of the earwig is very like the perfect insect, only without wings and wing-cases. It has very strong horny mandibles or jaws, and we know well the curious pair of pincers it carries about at the end of his body as if for defence. If we want to find a number of earwigs, we must look for them in some moist place, such as under a large stone or some decayed straw, and yet while it will live on animal food it will eat the leaves and petals of flowers.

Any injury, however, which earwigs do in a garden is made amends for by their eating in their turn many mischievous insects. It has been a very mistaken notion that earwigs were apt to get into people's ears, and the notion has perhaps originated from the name of the creature, and not the name from the practice of so doing. The word earwig comes in fact from ear, and the Saxon word weiga a worm. In German it is called Ohrwurm, and both names have probably come from the shape of its beautiful gauzy wings, which are just the form of the human ear. Perhaps too the notion has also been preserved from the habit which these little creatures have of creeping into holes during the day-time to hide from the light; at all events they seem to be always suspected of doing harm which never happens, and do not deserve to have gained such a bad reputation, since they show great affection for their offspring, and take the most tender care of them, the female earwig sitting on her eggs to hatch them, and then gathering the grubs under her body to protect them just as a hen does her chickens.

Among the different invaders of our gardens, there

are none, perhaps, whom we are so unwilling to have there as settlers, as those near relations of bees—the wasps. During the spring and early summer, we perhaps forget all about them, just at the very time when they are so busy themselves in constructing their dwelling places, and when too they are really serviceable to us, as we shall presently see; and it is only when they seem to appear on the scene as the natural enemies of the human race, that we begin to notice and dread the robbing and plundering propensities, and the fierce vindictiveness of our garden *rifle*-corps in its gaudy uniform of black and yellow.

Like the earwig, we after all give the wasp more credit for mischief than he deserves. He carries. it is true, a most formidable weapon—a sharp-pointed stiletto, which can be sent deep into our flesh, and a bag of poison, of which a single drop poured into the wound, can cause us hours, and even days, of pain and But has the wasp really any bloodinconvenience. thirsty designs towards us, or any natural desire to use his deadly weapons against us? Far from it. A wasp. in fact, only attacks and wounds us in self-defence. has a natural desire, it is quite true, for the sweet juices of plums and nectarines, and other luscious fruits, and once having taken possession of the ripest he can find if we should happen to want that particular plum or nectarine and disturb him in his feast, knocking him roughly, perhaps, as we detach it from the branch—he treats us as marauders and invaders of his rights, and stings us. He comes in at our open windows, attracted perhaps by the scent of sugar on our tables, and if we attempt to do battle with him as he flies about in search of the sugar-basin, he will again sting us in self-defence. Let us on such occasions remind ourselves that during the former part of his life, before fruit was ripe or windows left open, the wasp was feeding on just the kind of matter that we are glad to get rid of, and that before his taste for sweets has come to him he has been performing the office of scavenger, and feasting on putrid and impure animal substances of all kinds; and should we like to exchange the feeling of enmity too often nourished against him for one of wonder and admiration at his powers and clever works, let us find out all we can of his curious life and ways.

Like bees and ants, the wasps we are sure to find in our gardens live in communities, and have among them males, females, and neuters or working wasps. Their nests too, which contain something like the combs of the bee-hives, are found in banks and hollow trees, and such situations as are selected by wild-bees for their nests. The cells of wasps prepared for the reception of the eggs, from which the larvæ or grubs are hatched, and in which they are carefully fed by nursing wasps, and where they undergo the transformation into pupæ before becoming perfect wasps—these small cradles for their future population are formed not of wax like the cells of bees, nor of any substance at all resembling it, but of a sort of paper made of fine sawdust. Just of such a sub-

stance as we manufacture of paper and call papier-mache, or mashed paper, are formed the combs of wasps. Instead of collecting materials from flowers and digesting it into wax, as does the bee, the wasp rasps off fine fibres of wood from any paling, dead tree, or gate-post that he can get at, and mixing it with some gummy liquid, which his own body supplies, makes a pulp, which he spreads out into thin sheets of paper, and first lining the walls of the round nest with many layers of these, afterwards with the same material forms the cells, which, like storeys of numerous small apartments, fill up the nest.



SECTION OF WASPS' NEST, showing layers of cells.

The labour undergone by wasps in preparing their nests is even more wonderful than what is performed by bees within the hives which we prepare for them, and it seems to combine the mining and excavating power of the ant with the building talent of the bee, since the

first operation towards the foundation of a wasp colony, is the hollowing out of a long horizontal tunnel in some bank, with a large oval cave at the end, sufficiently capacious to be fitted up afterwards with layers of the tiny cradles wanted for the future population. The long tunnel and the large cave have both to be hollowed out with infinite labour by the gradual removal of the soil in the form of minute pellets carried in the wasps' jaws or mandibles, and which the cautious little workpeople are careful to carry away to some distance from the mouth of the tunnel, so as to prevent the situation of the secret passage being detected, through an accumulation of earth near its entrance. Then paper-making begins, and more wonderful industry and perseverance in kneading and plastering, and when the walls of the large cave are lined and tapestried with many layers of paper, there comes into operation lastly the same constructing skill as that of the bee, in forming the tiny six-sided cells, crowded together so as to take up as little space and material as possible; only that as each storey of cells is placed across the nest horizontally and is separate from each other storey, and not joined end to end, as in the combs of bees, the cells are flat at the bottom, and there is no occasion for the three-sided pyramid at the end of each, which is seen in the cell of the bee. storeys in the wasps' nest are, in fact, placed one above another, as in our own dwelling, only that a space is left between each storey, in order that the worker wasps may get to the young broods in the cells-for the combs

of wasps are never used for the storing up honey in, as those of bees. A most curious contrivance is adopted by the wasps, in order to secure the separation of the different storeys and the firmness of the whole nest. A little upright pillar of solid wasp-paper mortar is placed between each layer of cells, just as a human architect places pillars to support ceilings or roofs over large



apartments or buildings. When the cells are filled with grubs, the attention of the wasp nurses to the young is equal to that of bees, but it does not PORTION OF COMB, appear that any substance like the beewith supporting bread of kneaded pollen is formed for pillar, from Nest their food, but that the wasp brings home to the broods such food as she

feeds on herself-probably after it has undergone some change in her stomach, and it may be that her avidity for sweet juices may arise from her desire to carry it home for the young of her community. And when the cold of late autumn has crept on and the latest of juicy pears has been gathered, and windows never left open, the life and labours of the wasp end together, the colony is reduced down to a few males and females, and a few workers, who contrive to survive the frosts of winter, to begin again in the spring the construction of a new paper city, and are too busy over their work to notice in the blossoms of our fruit trees the preparation for their autumn feasts. Shall we not after all bid them welcome to a share of the dainties for which nature has given them a relish as well as ourselves?

In the form of the wasp with its slender waist, is seen very plainly the separation between the thorax or chest, and the abdomen or stomach, which forms one of the distinguishing marks of an insect, while in their lives, each individual passes through the three changes, which is peculiar to every other insect—first, the grub or larva; then, the chrysalis or pupa; and lastly, the perfect insect, such as the butterfly, ant, bee, and beetle, in which last form the creatures never grow.

And now let us fancy ourselves taking a walk round some garden with those who have been our readers, and let us pass in review some of the living creatures of whose lives and works we have endeavoured to give a history. If our walk be in the early morning, while grass and leaves are still damp with dew, we shall be very likely to meet with the "Slow One" of our first chapter, going home, perhaps, after his breakfast on juicy leaves of some kind, and we know that he will soon be shut up in his shell, and stuck fast against the smooth surface of some stone or tree bark, quietly digesting his food, while he makes a little addition to the size of his shell. We may see, too, many "Spinners and Weavers," seated in the midst of their delicate, glistening webs, waiting for flies, or if the owners of the webs be not there, we know that they are in nooks close at hand, most carefully concealed, but from out of which they

can easily run down to seize on their prey; and we may notice how cleverly the weavers of the great wheelshaped nets have contrived to moor them with long lines of web to some distant objects, and may calculate how many times their own length are some of those lines which they have ejected from their tiny spinnerets. pass on, and may contrive to see the Three-lived Ones in each of their states; as caterpillars, feeding on the leaves of plants and vegetables; or hanging to boughs or ledges of palings, in their pupa or chrysalis state; or meet them in their most perfect form, as lovely butterflies, fluttering about among flowers, or just resting on them long enough to send down their long drinking tubes into their nectaries. As we tread the gravel paths, we are sure to notice some doings of the "Underground Workers,"—some piles of earth thrown up while they have been excavating a cave-city, or we may see a long procession of them crossing a path, some going one way and some another, on important business no doubt; very busy and very fussy, and yet stopping occasionally to touch feelers and have a talk; or we may see where a number of them are making their way up the stem of some standard rose-tree, in order to "milk their cattle;" that is to say, take from the green aphides on the rose-buds and stalks the sweet honey-dew. We see here and there and everywhere that flowers and blossoms are to be found, the "Busy Ones" collecting honey and pollen, dipping their flexible tongues now into this flowercup and now into that, and burying themselves in others

so deeply that they come out white, or red, or yellow, with pollen, which is to be kneaded at home into beebread. During all the time of our walk we hear the cheerful trills and twitters and sweet notes of countless birds, and see them busy in their search after food, while we know that most of them have snug little nests in the trees and shrubs, and amid the ivy on walls about us, filled with young fledglings whom they never forget to provide for. As we pass a strawberry bed, we may chance to see some frog waiting with his large mouth and long tongue ready for trapping flies; or may chance to come upon a mole, who may have ventured up from his burrows underground. Even when we walk about our gardens in winter time, when all seems so still and quiet, we may remind ourselves of how much life there is still around us, or provision for future life. Ants down in their subterranean cities, taking their long winter sleep. Bees also dormant in their hives. Little mice snug and dozing in their warm nests; while in every nook and cranny of tree-trunks and branches, and in chinks of palings and walls, are eggs and pupæ of all manner of insects, waiting only for the warmth of spring to bring them into life.

And as we are reminded of all the creatures whose history, or even a portion of it, we have read, and whose ways we have been led to observe, we cannot but reflect with wonder on the abundance of life and the endless variety in the forms and modes of life to be observed even in the creatures who are to be found

within the compass of a garden. We have seen, too, how their bodies and all their powers are most wonderfully suited for the support and preservation of their lives. We have learnt that not only can each creature provide for itself, but has the inborn knowledge and impulse which we call instinct, prompting it to take most tender care of its young, or leading it to provide for its offspring beforehand, whom it will never see or know. We have seen how curious and marvellously skilful are some of the works of these small creatures for all these purposes—the web of the spider, the cell of the bee, the cocoon of the caterpillar, and the nest of the bird; and we know with what fidelity and unwearying patience and industry they employ all the capacities and powers given to them by nature; all which cannot fail to inspire us, not merely with love for them, but leads us to feel something like respect for these our little fellow-creatures, who, like ourselves, have received so many tokens of the loving-kindness and tender mercy of Him "who made and loveth all."



LONG-TAILED FIELD MOUSE.





